	Page 1		Page 3
1	Thursday, 17 January 2019	1	you have produced to assist the Commission.
2	(10.20 am)	2	May I ask you to go to page 19 of your slides,
3	MR PENNICOTT: Sir, before Mr Chow continues his questions		regarding Atkins' calculation. Yesterday, you said
4	to Mr Southward, could I just mention one administrative	4	that if I may just quote what you said for the
5	matter or in the nature of an administrative matter.	5	purposes of the record, it's yesterday's transcript
6	Sir, you may or may not recall that so far as the	6	page 119, starting from line 6 you said:
7	COWI report is concerned, the government posed a number	7	"So there are some aspects of this calculation that
8	of questions in writing to COWI. Those were transmitted	8	I don't fully understand. It's handwritten and so
9	to COWI earlier this week, and last evening we received	9	clearly it would be good to have a discussion with the
10	the answers from COWI, for which we thank them.	10	actual engineer by himself who wrote that. But if this
11	Just so that everybody is aware of where they are	11	is the approach they have used, then this is very
12	now, they were circulated last evening, I am told, at	12	conservative, and it would certainly demonstrate
13	about 7.40, with the daily bundle update, and they are	13	compliance for both change 1 and for the issue of
14	in tab 4.5 in the expert report bundle.	14	horizontal shear stresses for change 2."
15	CHAIRMAN: Good. Thank you.	15	Mr Southward, have you had a chance to look at
16	May I also mention, just for public knowledge, that	16	Prof Au's report, in particular his comment on Atkins'
17	we've started some 20 minutes late this morning because	17	calculation?
18	there were administrative matters that required	18	A. Yes, I have read his report.
19	convening a very brief meeting of counsel. Those	19	Q. I understand that Prof Au's criticism actually relates
20	administrative matters have now been dealt with and we	20	to four aspects of the calculations; do you recall that?
21	are able to proceed. Thank you.	21	A. Yes. Well, I can't remember the number, but yes. He
22	Yes, Mr Chow.	22	was critical of those calculations, yes.
23	MR NICHOLAS JOHAN SOUTHWARD (on former oath)		Q. I'm not going to ask you for details, but am I right to
24	MR CHOW: Good morning, Mr Chairman and Prof Hansford.	24	say that basically you don't agree with Prof Au's
25	Sir, before I continue with my discussion with	25	comment; is that right?
	Page 2		Page 4
1	Mr Southward, may I just raise one point of correction?	1	A. Well, I look at this calculation, which takes a bending
2	Mr Chairman, you will recall that yesterday, at one	2	moment and divides it by the lever arm between the top
3	point, when the Commission was dealing with the test	3	and the bottom of the wall section within the EWL and
4	report, at that point I informed the Commission that the	4	turns that into a shear force, and if and then
5	Buildings Department was notified of the date of the	5	there's a calculation for that shear force, for the
6	test and was requested to witness the test. Having	6	capacity based on that shear force.
7	taken further instructions, what I said was not entirely	7	And if that calculation is correct, then that is
8	correct.	8	a very conservative approach because there can't be any
9	It is still true that the test was not commissioned	9	more shear force. That shear force doesn't really
10	by the Buildings Department, but the Buildings	10	exist, because there's solid concrete going out on one
11	Department was notified two to three days before the	11	side and a third of the way out on the other side.
12	test and were invited to attend and the Ruildings	12	So to consider the wall in isolation is really very
	test and were invited to attend, and the Buildings		
13	Department was not supposed to validate or confirm the	13	conservative.
14	Department was not supposed to validate or confirm the propriety of the testing process. So that is a more	14	Q. Right. Fine.
14 15	Department was not supposed to validate or confirm the propriety of the testing process. So that is a more description of the position of the Buildings Department.	14 15	Q. Right. Fine.A. So that was my opinion.
14 15 16	Department was not supposed to validate or confirm the propriety of the testing process. So that is a more description of the position of the Buildings Department. COMMISSIONER HANSFORD: So their attendance was to witness	14 15 16	Q. Right. Fine.A. So that was my opinion.Q. I think all I need to do is just to register the
14 15 16 17	Department was not supposed to validate or confirm the propriety of the testing process. So that is a more description of the position of the Buildings Department. COMMISSIONER HANSFORD: So their attendance was to witness the test?	14 15 16 17	Q. Right. Fine.A. So that was my opinion.Q. I think all I need to do is just to register the government's disagreement on that and I will move on;
14 15 16 17 18	Department was not supposed to validate or confirm the propriety of the testing process. So that is a more description of the position of the Buildings Department. COMMISSIONER HANSFORD: So their attendance was to witness the test? MR CHOW: That's correct.	14 15 16 17 18	Q. Right. Fine.A. So that was my opinion.Q. I think all I need to do is just to register the government's disagreement on that and I will move on; right?
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14 15 16 17 18 19 20 21 22	Department was not supposed to validate or confirm the propriety of the testing process. So that is a more description of the position of the Buildings Department. COMMISSIONER HANSFORD: So their attendance was to witness the test? MR CHOW: That's correct. CHAIRMAN: Thank you. Cross-examination by MR CHOW (continued) MR CHOW: Good morning, Mr Southward. A. Good morning.	14 15 16 17 18 19 20 21 22	 Q. Right. Fine. A. So that was my opinion. Q. I think all I need to do is just to register the government's disagreement on that and I will move on; right? A. Sure. Q. Can I now refer you COMMISSIONER HANSFORD: Sorry, Mr Chow, why does the government disagree on that point?

	Page 5		Page 7
1	on the evidence of Prof Au, the criticism raised by	1	apart. If we can see that slide, that would be the
2	Prof Au in his report. It is to that extent that we	2	easiest.
3	cannot agree with Mr Southward.	3	So this top the slide on the image on the top
4	COMMISSIONER HANSFORD: Yes. Okay. Thank you.	4	right-hand corner, you will see there's two plates, and
5	MR CHOW: Mr Southward, can I refer you to page 21 of your	5	there's a bolt that goes through the middle of those two
6	slide, where you talk about dowel action resistance.	6	plates.
7	If I may then refer you back to yesterday's	7	Q. Yes.
8	transcript at page 120, starting from line 3, where you	8	A. Now, that bolt has got a rounded stud on the top and
9	talked about the dowel action and the slide showing the	9	a rounded stud on the bottom. That is drawn
10	yellow block. Do you recall that?	10	diagrammatically, I guess, as the nut and the head of
11	A. Yes.	11	the bolt.
12	Q. You said:	12	Now, if you took the nut and the head of the bolt
13	"Looking at a close-up detail of the yellow slice,	13	off, if you removed the nut and the head of the bolt,
14	we can see there are two layers of T50 vertical bars and	14	there's no anchorage to the bit of bolt that's in
15	two layers of T40 bars that cross this interface. So	15	between the two plates.
16	these are the vertical bars drawn in black. Two of	16	Q. Yes.
17	those bars are T40 bars and two of those bars are T50	17	A. So there's no anchorage. But I'm sure you would agree,
18	bars.	18	that bolt is still working, it's still there, working in
19	There is so much reinforcement, in fact, that the	19	dowel action.
20	basic shear capacity of the steel bars in dowel action	20	Q. Right.
21	alone is enough to resist the tension load developed in	21	A. So that's why I say that you don't need the bolt to go
22	the horizontal T40 bars at the top of the slab. So you	22	400 millimetres up, above the top plate. You don't need
23	can see the red arrow which is that's the tension	23	it to be anchored, because dowel action is just the
24	force in the T40 bars, and that is pulling the yellow	24	action of (demonstrating with a pen) this pencil
25	slice to the left. That pulling is basically resisted	25	breaking, being sheared sideways.
	Page 6		Page 8
1	by the steel bars. The steel bars would have to be	1	Q. Thank you.
2	sheared. The steel bars would have to break in order	2	Then if I may go to your expert report.
3	for the yellow slice to move."	3	Mr Southward, do you know Mr John Blackwood of Atkins?
4	Can you see that?	4	CHAIRMAN: Sorry, could I just ask one question there, to go
5	A. Yes, I can.	5	back. I appreciate the point you're making, that you've
6	Q. My question is this. The T50 bars that you are talking	6	
7	C J J		got the bolt it may not have the top and the bottom
	about are the vertical bar on your slide; is that	7	got the bolt it may not have the top and the bottom but it's still there, and so on a straight shear force
Ιð	about are the vertical bar on your slide; is that correct?	7	but it's still there, and so on a straight shear force
8 9	correct?	7 8	but it's still there, and so on a straight shear force basis it's still operating, even though it's not
9	correct? A. Yes. I recall that the two bars closest the two	7 8 9	but it's still there, and so on a straight shear force basis it's still operating, even though it's not anchored.
9 10	correct? A. Yes. I recall that the two bars closest the two vertical bars closest to the right are the T50 bars, and	7 8	but it's still there, and so on a straight shear force basis it's still operating, even though it's not
9	correct? A. Yes. I recall that the two bars closest the two vertical bars closest to the right are the T50 bars, and inside, the third bar is the T40, and then on the other	7 8 9 10	but it's still there, and so on a straight shear force basis it's still operating, even though it's not anchored. But would shear force operate together with some
9 10 11 12	correct? A. Yes. I recall that the two bars closest the two vertical bars closest to the right are the T50 bars, and inside, the third bar is the T40, and then on the other face, on the left side, it's a T40 bar.	7 8 9 10 11	but it's still there, and so on a straight shear forcebasis it's still operating, even though it's notanchored.But would shear force operate together with someform of other dynamic, such as vertical force, whichmight then, because that bolt is not anchored, lift the
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 9 10 11 12 13 14 15 16 17 18 19 	 correct? A. Yes. I recall that the two bars closest the two vertical bars closest to the right are the T50 bars, and inside, the third bar is the T40, and then on the other face, on the left side, it's a T40 bar. Q. So the dowel bars that you refer to are the vertical black bars? A. Those are the main steel reinforcement in the diaphragm wall. Q. Do you agree that to be able to mobilise the dowel action, one has to ensure that we have adequate 	7 8 9 10 11 12 13 14 15 16 17 18 19	 but it's still there, and so on a straight shear force basis it's still operating, even though it's not anchored. But would shear force operate together with some form of other dynamic, such as vertical force, which might then, because that bolt is not anchored, lift the bolt in some way or drop the bolt in some way, and then allow the shear force to operate? A. Well, okay. In the example on the screen, if you took the head of the bolt and the nut of the bolt off, there's a chance that the bolt might fall through because there's nothing below it. But in this case, there's a concrete diaphragm wall, so the bars aren't
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9 10 11 12 13 14 15 16 17 18 19 20 21 22	 correct? A. Yes. I recall that the two bars closest the two vertical bars closest to the right are the T50 bars, and inside, the third bar is the T40, and then on the other face, on the left side, it's a T40 bar. Q. So the dowel bars that you refer to are the vertical black bars? A. Those are the main steel reinforcement in the diaphragm wall. Q. Do you agree that to be able to mobilise the dowel action, one has to ensure that we have adequate anchorage length, that is the portion of the vertical bar inside the yellow block? A. Not no. No. I don't agree with that. Would you like me to explain or 	7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	 but it's still there, and so on a straight shear force basis it's still operating, even though it's not anchored. But would shear force operate together with some form of other dynamic, such as vertical force, which might then, because that bolt is not anchored, lift the bolt in some way or drop the bolt in some way, and then allow the shear force to operate? A. Well, okay. In the example on the screen, if you took the head of the bolt and the nut of the bolt off, there's a chance that the bolt might fall through because there's nothing below it. But in this case, there's a concrete diaphragm wall, so the bars aren't going anywhere. CHAIRMAN: Yes. A. What other complementary actions there are I mean,

	Page 9		Page 11
1	The purposes of that sketch was to provide	1	Q. But that is your assumption. Your assumption is that
2	a response or to say that that free body diagram does	2	A. Well, it's reality, that's what happens.
3	work, and in that free body diagram there are no other	3	Q the construction joint was properly prepared, the
4	forces acting.	4	surface of the construction joint was properly prepared
5	CHAIRMAN: Of course. I suppose my question then is, using	5	before casting of the new concrete. This is your
6	the words that you use so much better: when you are	6	assumption.
7	looking at shear force and on a day-to-day design basis,	7	A. Well, okay I was not on site at the time of the
8	you presumably don't look at that in isolation, you look	8	preparation of the construction joint, so yes, I did not
9	at complementary forces?	9	see with my own eyes that the construction joint was
10	A. That's right, so there's axial load, there's bending	10	prepared in accordance with the specs. No, I didn't.
11	moments and there's shear. So outside of the diaphragm	11	But I am told that it was prepared so I can only rely on
12	wall, at the junction of the wall and the slab, there	12	that.
12	are bending moments, shears, axial loads. So those are	12	Q. Later on I will take you to some of the photos, but for
13	complementary.	13	the present purpose, so you agree do you agree with
14	In this particular case, in this horizontal slice,	14	me that this is one of the components of
16	we are just talking about shear, and that's the concern	16	A. Sorry, you will have to go back to "this is one". What
17	of Prof Au, the shear stresses across that joint.	17	is "this"? You said "this is one of the components"
18	CHAIRMAN: Thank you.	18	can you just remind me what "this" is?
19	MR CHOW: Mr Southward, can I just quickly clarify one more	18 19	Q. The dowel bar will mobilise the friction between the two
20	thing regarding the dowel action. Am I right in	20	concrete surfaces to resist the shear force?
20	thinking that the dowel action actually is comprising of	20	A. The dowel bar will mobilise the friction between the
21	two elements? The first element is because of the dowel	21	two no, I don't understand that.
22	bar, if there is sufficient anchorage, then it will	22	Q. Fine. The second component is the one you have just
23 24	generate a compressive force between the concrete	23 24	g. Fine. The second component is the one you have just mentioned, make use of the dowel bar and that will
	surface, and that compressive force will mobilise the	24 25	
25	-	23	generate bearing stress on the concrete surrounding the
1	Page 10	1	Page 12
1	shear resistance, the friction between the concrete	1	dowel bar.
2	surface. This is one element of the dowel action. Do	2	A. Yes.
3	you agree or	3	Q. Have you checked whether you mentioned about there
4	A. Sorry, that	4	are lots of reinforcement, T50, T40, to be able to work
5	Q. That would be one component of the dowel action?	5	as a dowel bar have you checked the stress generated
6	A. I don't can you repeat again clearly? I can't	6	on the surrounding concrete, to make sure that the
7	Q. Because of the dowel bar, when it is subjected to shear	7	concrete can withstand the stress?
8	motion, then it will mobilise tension within the dowel	8	A. No, I have not.
9	bar, and the reaction will be resisted by will exist	9	Q. Thank you.
10	between the concrete surface that the dowel bar tries to	10	CHAIRMAN: Do you think you should have done? That's
11	connect together?	11	I suppose the natural question.
12	A. There will be some are you talking about the bearing	12	A. Well, I mean, I've had limited time. I think if one
13	stresses in the steel bar against the concrete? Is that	13	really needs to do that calculation in Prof Au's way,
14	what you are referring to? Q. That is the second component that I am going to. But do	14	you actually need to look at a much bigger picture,
15	LL Lingt is the second component that I am going to But do	15	because looking at this little yellow slice, it's
1 -	· · · · ·		
16	you agree with me that the reason why dowels can help to	16	physically impossible for it to move, and that is
17	you agree with me that the reason why dowels can help to resist lateral movement, part of the action actually	16 17	actually evidenced by reality because it's not moved.
17 18	you agree with me that the reason why dowels can help to resist lateral movement, part of the action actually goes to the fact that it will mobilise the friction	16 17 18	actually evidenced by reality because it's not moved. So if you were to do this kind of check, you would
17 18 19	you agree with me that the reason why dowels can help to resist lateral movement, part of the action actually goes to the fact that it will mobilise the friction between the two concrete surfaces?	16 17 18 19	actually evidenced by reality because it's not moved. So if you were to do this kind of check, you would look at the whole element. Maybe perhaps can I draw
17 18 19 20	you agree with me that the reason why dowels can help to resist lateral movement, part of the action actually goes to the fact that it will mobilise the friction between the two concrete surfaces?A. Well, there aren't two concrete surfaces. Here, it's	16 17 18 19 20	actually evidenced by reality because it's not moved. So if you were to do this kind of check, you would look at the whole element. Maybe perhaps can I draw and show you?
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 17 18 19 20 21 22 23 	you agree with me that the reason why dowels can help to resist lateral movement, part of the action actually goes to the fact that it will mobilise the friction between the two concrete surfaces?A. Well, there aren't two concrete surfaces. Here, it's one monolithic piece of concrete. There is only this artificial construction joint that has been properly prepared and made ready so that, in the eyes of design,	 16 17 18 19 20 21 22 23 	 actually evidenced by reality because it's not moved. So if you were to do this kind of check, you would look at the whole element. Maybe perhaps can I draw and show you? CHAIRMAN: Of course. A. (Drawing on the whiteboard) I think, from recollection, it's something like that, isn't it? The D-wall comes up
 17 18 19 20 21 22 	you agree with me that the reason why dowels can help to resist lateral movement, part of the action actually goes to the fact that it will mobilise the friction between the two concrete surfaces?A. Well, there aren't two concrete surfaces. Here, it's one monolithic piece of concrete. There is only this artificial construction joint that has been properly	16 17 18 19 20 21 22	actually evidenced by reality because it's not moved.So if you were to do this kind of check, you wouldlook at the whole element. Maybe perhaps can I drawand show you?CHAIRMAN: Of course.A. (Drawing on the whiteboard) I think, from recollection,

3 (Pages 9 to 12)

	Page 13		Page 15
1	and then we've got reinforcement that comes down there	1	interface, and after that there may be other cracks
2	and we've got reinforcement that comes here and across	2	develop vertically on the two sides of the diaphragm
3	here, I think.	3	wall. This is how Prof Au explains to the Commission.
4	I've run out of colours, but Prof Au is saying we	4	So Prof Au is not anticipating that the whole
5	need to be looking at the stresses across that interface	5	horizontal slice of the whole EWL slab would slide, and
6	there (indicating red dotted line) in isolation, by	6	he considers cracks developing in that way, the concrete
7	itself, and really, that slide, it can't move. Well, it	7	is considered to have failed. What is your response?
8	hasn't moved and it can't move. But if you did want to	8	A. But he sat here and said that this bit up here is going
9	look at things moving, you would look at that section	9	to slide and we need to check to make sure it's not
10	(drawing blue dotted line) all the way.	10	sliding. That's what he said.
11	Maybe, actually, if you could look at the slide on	11	I believe there was talk about well, okay,
12	the screen, you see the way the structure in fact,	12	I mean, it was three days ago now but I think he was
13	I think there were two this slide and also the slide	13	talking about the subsequent signs of distress, what
14	before shows how that when things are struck	14	might happen afterwards and the cracking, but that's
15	together, they bend, but when things aren't stuck	15	just a guess. I can't remember.
16	together they bend independently.	16	Q. All right. Let's move on then.
17	COMMISSIONER HANSFORD: That's it.	17	A. Okay.
18	A. Yes.	18	Q. Mr Southward, just now I've asked whether you know
19	So if when looking at this slab (indicating) and	19	Mr John Blackwood of Atkins.
20	this slab is being bent downwards, then we could imagine	20	A. I have met him maybe once or twice. I think maybe five
21	that there was a slice all the way along here (extending	21	or six years ago I was on the Association of Consulting
22	the dotted red line). So imagine that line is one of	22	Engineers council and I can't remember whether
23	the lines on the slide.	23	Mr Blackwood was a member there or not. But I met him
24	So you would have to check that the whole plane	24	a couple of times, but not more than that.
25	didn't slide, not just one small plane.	25	Q. All right. Don't worry about it.
	Page 14		Page 16
1	Page 14 Does that make sense?	1	Page 16 The reason why I ask is because Mr Blackwood gave
1 2		1 2	-
	Does that make sense?		The reason why I ask is because Mr Blackwood gave
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1	Page 17		Page 19
1	Q. And they are not governed by the Buildings Ordinance?	1	in, why we are not going to involve ourselves in a legal
2	A. Yes, highway infrastructure projects are exempt. They	2	determination of what constitutes a foundation in
3	are not governed, yes.	3	Hong Kong, according to the various documents that
4	Q. Without disrespect, my instructions are that you are not	4	relate to Hong Kong but may not relate to other
5	an authorised person in Hong Kong.	5	jurisdictions.
6	A. That is correct, I'm not an AP and I'm not	6	So as I understand, Mr Southward, you are saying
7	Q. You are not a registered structural engineer in	7	your approach was an engineer's approach to it?
8	Hong Kong either?	8	A. Yes.
9	A. That is correct.	9	CHAIRMAN: Not a quasi-legal or legal approach?
10	Q. So you may not claim any expertise in dealing with	10	A. That's why I quoted from an engineering textbook, to
11	design submission with the Buildings Department, getting	11	give some weight to my statement.
12	approval or the operation of the practice notes issued	12	CHAIRMAN: All right. Yes. And your expertise that you've
13	to the AP and RSE; am I right?	13	put forward today, and in terms of which you are giving
14	A. Certainly, we have done work on Buildings Department	14	evidence, is as a design consultant?
15	projects. So we have done that over the past so many	15	A. Yes.
16	years, we've certainly done work on Buildings Department	16	CHAIRMAN: Looking at the overall safety of the structures,
17	projects.	17	because that's the type of work you've been doing
18	But yes, I'm not a RSE, so, you know, you are	18	A. Yes.
19	correct there.	19	CHAIRMAN: on complex structures over an extended period
20	Q. When you say "we" you mean your company?	20	of time?
21	A. Yes.	21	A. Yes.
22	Q. But I'm talking about you yourself. Do you claim any	22	CHAIRMAN: So not purely as a structural engineer? So you
23	expertise in this area?	23	are not giving evidence purely as you are giving
24	A. I'm a project director of all our projects and I see	24	evidence on a broader basis of design and safety, which
25	everything that goes on. So, for example, we are	25	takes in all these various issues?
	Page 18		Page 20
1	working on a project at the moment which will be	1	A. Yes, but the structural engineering aspect is key to the
2	submitted to BD at some point and, you know, I'm	2	safety.
3	involved in the review of those documents.		
		3	CHAIRMAN: Okay.
4	Q. So you said you have the expertise, right; is that your	3 4	A. So that's the main bit.
4 5	answer?		A. So that's the main bit. CHAIRMAN: And that's what you do all the time?
	answer? A. No, I'm just saying that I have experience of working on	4	A. So that's the main bit.CHAIRMAN: And that's what you do all the time?A. That's what I do every day, yes.
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Q. So not a structural engineer?

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yes, that's correct.

question of whether the construction joint, the

interface between the new concrete and the old concrete

of the diaphragm wall has been properly prepared. Your

assumption is in terms of quality, there's no problem,

so it is a monolithic -- after the new concrete is cast,

it is a monolithic part of the whole structure; right?

A. If the construction joint is properly prepared, then

			c , , , , , , , , , , , , , , , , , , ,
2	A. I'm not a member of the Institution of Structural	2	telling the Commission that first of all the interface
3	Engineers in the UK. So it depends how you say that.	3	was not horizontal, so it's different from what people
4	I practise civil engineering sorry, strike that.	4	assume today, and we have some photos I would like you
5	I practise structural engineering and I am qualified in	5	to look at to see whether you agree or not. Bundle B19,
6	that because I am a member of the Institution of Civil	6	page 25581, please.
7	Engineers and the Hong Kong	7	You see the part which is clouded in red?
8	COMMISSIONER HANSFORD: We may be getting into quite	8	A. Yes. It's not a very good photo. Maybe if you could
9	an interesting area here interesting for you and I,	9	zoom in a bit.
10	Mr Southward, because of course civil engineering	10	Q. I think that can be done, yes. Actually, Mr Jason Poon
11	embraces structural engineering	11	described something like an A shape. Accidentally,
12	A. Absolutely.	12	I found this photo, so obviously it is not
13	COMMISSIONER HANSFORD: but the Institution of Structura	13	horizontal; do you agree?
14	Engineers and we will be hearing from Dr Glover and	14	A. Yes. If that's the construction joint, then yes, it's
15	from Prof McQuillan later in these proceedings is	15	not horizontal. It looks but then is this actually
16	a specialist branch that focuses on structural	16	what it was before they I mean, there's no slab here;
17	engineering. Am I correct?	17	right? In fact, which side of this is the slab and
18	A. Yes. So I mean, in my very basic a basic way of	18	which side of this is the OTE?
19	putting I don't design high-rise buildings, you know,	19	MR PENNICOTT: What's the date of the photo?
20	the Nina Tower that kind of structure, that is	20	MR CHOW: Honestly, I can't help you, because this is
21	structural engineering, whereas this kind of structure	21	a photo produced by the MTR and the annotation is by MTR
22	here that we're talking about here is civil engineering.	22	as well, "Breaking out top of diaphragm wall and top
23	COMMISSIONER HANSFORD: But nevertheless, as I read from	23	couplers removed".
24	your CV, you were a director of Benaim and other	24	COMMISSIONER HANSFORD: Mr Chow, this is one of the issue
25	reputable structural engineering companies?	25	with photographs, isn't it? They are snapshots in time.
	Page 22		Page 24
1	A. Indeed, yes. I mean, Tony Gee is a civil and structural	1	A. Yes.
2	and geotechnical consultant.	2	COMMISSIONER HANSFORD: And we don't know if the concrete
3	COMMISSIONER HANSFORD: Thank you.	3	was poured immediately afterwards or if there was work
4	MR CHOW: Mr Southward, on the issue of whether prior	4	done before the concrete we don't know.
5	consultation with BD for the second change is required	5	MR CHOW: It's a fair observation.
6	prior to the implementation, I have read your report, in	6	COMMISSIONER HANSFORD: So it's quite difficult to rely on
7	fact the majority part of your report goes to that	7	these, isn't it? I'm just asking the question: how
8	issue. Am I right to summarise as follows: your	8	could we rely on them, Mr Chow?
9	position is, first of all, PNAP-19 does not apply, but	9	MR CHOW: Well, this photo seems to support what Mr Jason
10	if it applies then your view is, first of all, the	10	Poon said, part of his factual evidence. That's why
11	connection that is in question is part of the	11	I need to at least show it to Mr Southward, because one
12	superstructure and therefore, under PNAP ADM-19, it is	12	of his assumptions was first of all the drawing was
13	exempted because the changes is minor? Is that a fair	13	prepared, as we saw on the drawings, which is
14	summary of your view?	14	horizontal. Then the next photo I would like
15	A. More or less, yes.	15	Mr Southward to look at goes to the quality of the
16	Q. Thank you.	16	interface.
17	Just now you mentioned we had an exchange on the	17	COMMISSIONER HANSFORD: Presumably, Mr Jason Poon would not
10	question of whether the construction joint the	19	have noured concrete until the joint was correctly

Page 21

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- have poured concrete until the joint was correctlyprepared, would he? Anyway, maybe that's not a question
- 20 for you, Mr Chow, is it?
- 21 MR CHOW: I can't help on that.
- 22~ A. There's no reinforcement there. There's no formwork.
- 23 There's nothing there. So how -- that's not ready for
- 24 concreting, that photograph.
- 25 COMMISSIONER HANSFORD: No.

Page 23

Q. We've had some factual evidence from Mr Jason Poon,

	Page 25		Page 27
1	A. So who knows what	1	is anybody doing pouring concrete on it? I mean, that
2	MR CHOW: I hear what you say. I show you the photo.	2	strikes me as another issue entirely.
3	There's some factual evidence saying that the interface	3	But we will come to that.
4	was prepared in an A shape, and I found this among the	4	MR CHOW: I'm afraid I am not able to assist on that.
5	photos produced by MTRC, to be fair to you	5	If I may then move on. Mr Southward
6	COMMISSIONER HANSFORD: I think this shows us that at som	e 6	CHAIRMAN: Sorry, if I can I put this out as a statement,
7	point in time, it was an A shape.	7	I don't make it as a question, but it seems to me that
8	MR CHOW: Yes, that is a possibility.	8	by and large, unless you've got compelling evidence
9	CHAIRMAN: I don't even see that, I'm afraid.	9	otherwise, fairly obvious structural matters like that,
10	MR CHOW: Perhaps for the benefit of the Chairman, we can	10	which are being put into preparation so that they are
11	blow up the central part of the photo which is clouded.	11	part of a larger structure with concrete pours, one must
12	CHAIRMAN: Oh, you mean the bit in the middle? Thank you.	12	assume regularity, unless there's good reason not to,
13	MR CHOW: Yes.	13	because otherwise we are going to be looking at every
14	A. You can't actually see it though. The quality is not	14	last little tiny bit of this structure.
15	very good.	15	COMMISSIONER HANSFORD: I think we are also assisted by the
16	Q. If I may ask you to look at another photo in the same	16	hold point and the inspections, the pre-pour
17	bundle, 25587.	17	inspections, or we should be. So they are designed to
18	CHAIRMAN: Again, I don't wish to belabour matters, but as	18	ensure, as I understand it, that concrete pours are
19	Prof Hansford has said it's a shot of a moment in time.	19	ready before the concrete is poured.
20	How do we know that the work on that particular piece of	20	Now, I don't recall evidence to say that such hold
21	structure was complete?	21	points had been missed.
22	MR CHOW: Mr Chairman, the next photo that I would invite	22	CHAIRMAN: And also, with respect, and in support of
23	Mr Southward to look at will not have this problem.	23	Mr Jason Poon, Mr Jason Poon, to my understanding and
24	CHAIRMAN: All right.	24	I'm open to correction merely said that he observed
25	MR CHOW: Because the next photo shows that the	25	that some of the work being done resulted not in
	Page 26		Page 28
1	reinforcement is almost completed, and we can see,	1	an entirely horizontal cut but left a sort of A shape.
2	again, in the area which is clouded, it seems to suggest	2	And he didn't say that was how it remained and that was
3	that it is part of the top of the diaphragm wall. We	3	how it was poured upon. He merely spoke about the
4	see horizontal reinforcement had been fixed, and	4	quality of work that he saw in passing, so to speak.
5	honestly, I'm not an expert, but my question for	5	Do you see the point I make? Because, of course, if
6	Mr Southward is: the bit in between the two lines of	6	he had have said, "And that was what I was faced with
7	vertical blue reinforcement, would it be the concrete	7	when I had to pour the concrete", then, as
8	surface, after hacking off?	8	a professional man, no doubt, running his own operation
9	A. That looks to be the concrete, yes.	9	and with responsibility to ensure that it operated
10	Q. Would this appear to you not to have been roughened,	10	properly, he would have been obliged, because he was now
11	aggregate had not been exposed?	11	the one responsible, to say, "This is not a properly
12	A. Well, it looks quite rough to me. Clearly, you can't	12	prepared surface", and I don't recall him ever saying
13	measure from the photograph I don't know whether the	13	anything like that.
14	quality of the photograph is good enough to zoom in	14	MR CHOW: Not that I'm aware of either, sir.
15	is it? You can't really see anything there.	15	CHAIRMAN: No.
16	Q. Thank you. So I will move on.	16	MR CHOW: The reason why I need to show or bring to the
17	CHAIRMAN: Sorry, is what's being suggested here and this	17	attention of the Commission these photos is because
18	is a new matter to me I'm well aware of Mr Jason	18	other experts make the point that it is important to
19	Poon's observations, and there was some time spent on	19	ensure that the interface is properly prepared,
20	it, that it was sort of A-shaped, in a way, when it was	20	aggregate are exposed, to ensure that after the casting
21	cut down.	21	it will become a monolithic part of the whole structure.
22	But I think what concerns me now is the broader	22	And when I noticed this photo, given the duty of the
23	issue, which Prof Hansford has just raised, which is	23	Commission, I am duty-bound to at least bring to the
24	that if this cutting down was not properly prepared, so	24	attention of the Commission.
25	that it would be structurally safe, then what on earth	25	CHAIRMAN: No, it's not a criticism. This type of debate or

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	Page 29		Page 31
1	interchange between the counsel and the Commission is	1	A. The question about properly preparing a construction
2	quite proper and assists. But what we are saying,	2	joint this concrete was originally up here (drawing
3	I think, is that Mr Jason Poon did not say, "I poured	3	red line at the top), way above the top of the final
4	concrete in accordance with my contract on top of	4	level, and then it was broken down.
5	an ill-prepared surface." He did not say that. He	5	So in the breaking down, you use a big machine to do
6	spoke about to use French, which I'm not supposed to	6	the top bit and then you go into small, hand-held
7	do, I suppose, in courts today he spoke about what he	7	breakers, and in doing that, that is going to guarantee
8	saw en passant. That's all he did.	8	that the finish of the concrete is going to be properly
9	I think there's been no other suggestion that this	9	prepared, because you are basically hammering out the
10	was wrong. I'm happy for a hypothetical question to be	10	bits of the concrete. So you are going to get a rough
11	put, that "What would be the case if it wasn't	11	finish.
12	prepared?", but I'm not happy to now have another	12	So I don't have any doubt, because they were up here
13	factual issue, which nobody has touched upon in several	13	and they went down here (indicating), I don't have any
14	weeks of this Inquiry, now falling for determination,	14	doubt that the surface would have been properly
15	because I think so far everybody accepts that whatever	15	prepared.
16	the work may have been in passing, at the end of the day	16	The question about the profile we talked about
17	nobody suggests that it wasn't properly prepared.	17	dowel action earlier, but if we got this slab (drawing
18	COMMISSIONER HANSFORD: But it would be interesting to know		a horizontal red line), and we got Prof Au's free body
19	what would be the case if it were not properly prepared,	19	slice, which was this slice here (drawing a red box),
20	so we might proceed on that basis, if it suits you.	20	and he doesn't want that slice to move sideways well,
21	MR CHOW: Yes. Thank you.	21	now we've got a shear key there (indicating), inside,
22	Mr Southward, may I ask, if the interface between	22	that is actually stopping the body from moving
23	the new and old concrete had not been properly prepared,	23	regardless of the reinforcement.
24	would it have any effect on your view?	24	So, okay, we don't know whether it was done that
25	A. Can you define what you mean by "properly prepared"?	25	way, but if it had been done that way, that would
			•
	Page 30		Page 32
1	-	1	Page 32 actually be better than it being a flat surface.
1 2	Q. The aggregate was not properly exposed, surface was not	1 2	
	Q. The aggregate was not properly exposed, surface was not clean, for example.		actually be better than it being a flat surface.
2	Q. The aggregate was not properly exposed, surface was not clean, for example.A. There is a specification requirement for preparing	2	actually be better than it being a flat surface. COMMISSIONER HANSFORD: Right. But it would be the case
2 3	Q. The aggregate was not properly exposed, surface was not clean, for example.	2 3	actually be better than it being a flat surface. COMMISSIONER HANSFORD: Right. But it would be the case that it would complicate the analysis of the free slice?
2 3 4	Q. The aggregate was not properly exposed, surface was not clean, for example.A. There is a specification requirement for preparing a construction joint, which means removing the latent, which is the stuff that floats to the surface of	2 3 4 5	actually be better than it being a flat surface. COMMISSIONER HANSFORD: Right. But it would be the case that it would complicate the analysis of the free slice? A. It wouldn't make any difference to the analysis
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1	A-shaped construction joints.	1	The term superstructure is commonly used to describe
2	A. I don't know. I don't know.	2	the engineered part of the system bringing load to the
3	MR CHOW: Mr Southward, I would like to move on to the next	3	foundation, or substructure."
4	topic. Earlier, you mentioned about the textbook that	4	So these are the two sentences that you quote in
5	you referred to, the foundation analysis. Do you recall	5	your report to support your view. However, the book
6	that, Foundation Analysis and Design?	6	does not stop here. If you turn over the page to
7	A. Yes.	7	page 3, basically, in section 1-3, it is where this book
8	Q. In support of your view that the connection in question	8	tells us how to classify and what kind of structures
9	should be treated as part of the superstructure. Do you	9	should be considered as foundation. Section 1-3:
10	recall that?	10	"Foundations may be classified based on where the
11	A. Yes.	11	load is carried by the ground, producing:
12	Q. But you have not if I am correct, you have not	12	Shallow foundations termed bases, footings,
13	provided copies of that textbook, have you?	13	spread footings, or mats. The depth is generally D/B
14	A. No, I didn't realise I was supposed to, I'm sorry. They	14	less than 1"
15	are expensive! Ignore me.	15	Meaning the depth against the width of the
16	Q. I have managed to get somebody providing support to me	16	foundation. If it is less than or close to 1, it is
17	to download the relevant part of that textbook,	17	considered to be a shallow foundation. Then:
18	apparently free of charge, from the internet. If I may	18	"Deep foundations piles, drilled piers, or
19	perhaps distribute. (Handed).	19	drilled caissons. Lp/B is greater or equal to 4"
20	COMMISSIONER HANSFORD: Which textbook is this?	20	Then the next paragraph:
21	MR CHOW: This is Foundation Analysis and Design referred to		"Figure 1-1 illustrates general cases of the three
22	by Mr Southward in paragraph	22	basic foundation types considered in this text and
23	A. Joseph Bowles?	23	provides some definition commonly used in this type of
24	Q 14.2, page 40 of Mr Southward's report.	24	work. Because all the definitions and symbols shown
25	COMMISSIONER HANSFORD: Thank you.	25	will be used throughout the text, the reader should give
	Page 34		
			Page 36
1	MR CHOW: You relied on this textbook in support of your		this figure careful study."
2	argument that the connection we are looking at should be	2	Figure 1-1 is on the next page. You see on the next
3	treated as superstructure.	3	page we have three types of structures, all considered
4	If I may refer you to the relevant part. The part	4	to be foundation: (a) is the spread foundation that we
5	that you have quoted actually can be found right in the	5	have just looked at, (b) is the pile foundation, and (c)
6	first paragraph of the book, chapter 1, the first	6	is the retaining structure.
7	paragraph of chapter 1 of the book, where it says:	7	Now, do you agree with me that the part of the
8	"All engineered construction resting on the earth	8	diaphragm wall between the EWL slab and NSL slab is
9	must be carried by some kind of interfacing element	9	a retaining structure?
10	called a foundation."	10	A. It is a retaining structure, yes.
11	And under footnote 1 it makes a point that:	11	Q. If I may just complete the relevant part that I intended
12	"This is also sometimes called the substructure."	12	to show to you. Page 5, the third paragraph from the
13	So according to this book, "foundation"/"structure"	13	top, starting with "Any structure"; do you see that?
14	are interchangeable.	14	A. Yes, I see it.
15	Then is the statement that you relied on and quoted	15	Q. "Any structure used to retain soil or other material
16	in your report:	16	(see figure 1-1(c) [the one we have just looked at]) in
17	"The foundation is the part of an engineered system	17	a geometric shape other than that naturally occurring
18	that transmits to, and into, the underlying soil or rock	18	under the influence of gravity is a retaining structure.
19	the loads supported by the foundation and its	19	Retaining structures may be constructed of a large
20	self-weight."	20	number of materials including geotextiles, wood and
21	And it goes on to say:	21	metal sheeting, plain or reinforced concrete, reinforced
22	"The resulting soil stresses except at the ground	22	earth, precast concrete elements, closely spaced
23	surface are in addition to those presently existing	23	pilings"
24 25	in the earth mass from its self-weight and geological	24	Do you agree with me that the diaphragm wall that we
	history.	25	have with interlocking can be considered if we want

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1	to refer to this paragraph, actually it's akin to	1	A. No. I mean, it doesn't work like that. You can't just
2	a closely spaced piling to resist to retain the soil	2	ring up and say, "Can you help me here?" You know,
3	on one side?	3	you've got to make formal submissions.
4	A. Well, closely spaced piling refers to things like	4	CHAIRMAN: Okay. Good.
5	contiguous bored pile walls, which is not the diaphragm	5	A. You do the work, you read the documents first to make
6	wall.	6	sure you're fulfilling the criteria. You do the work,
7	Q. Of course, but what I'm saying is how it works, the	7	you prepare the submissions, and then they are
8	diaphragm wall that we use in this project is akin to if	8	submitted, and then there's a review period, which takes
9	we want to somehow relate to the closely spaced piling	9	a while. So you don't have as far as I know, there's
10	or any one type of structure here, the closely spaced	10	no facility for, "Can I have some advice here, please"
11	piling would be the appropriate reference; right?	11	on this.
12	A. Well, I mean, you are just looking at the words. The	12	CHAIRMAN: I'm not talking about a helpline, as such
13	words say "closely spaced piling", they don't say	13	I don't mean that facetiously but I'm wondering if
14	"diaphragm wall". And on the issue of retaining walls	14	you can write in, formally, to the Buildings Department
15	and diaphragm walls retaining walls and foundations,	15	and say, "We intend to do this, we see it not as
16	in Hong Kong they are two very distinct elements.	16	a design change, but before proceeding can you give us
17	There is a code of practice for design of	17	the okay", or will you then get a request to formalise
18	foundations, and there is also a separate document which		it?
19	is a code of practice for design of retaining walls. So	19	A. I don't know because I've not been in that situation,
20	they are separate.	20	sir.
20	Q. All right. Looking at we have now looked at the	21	CHAIRMAN: All right. So for you, if ever there's going to
21	relevant part of the textbook that you relied on. Do	21	be a change, because of the formalities of the process,
22	you agree with me that the connection we are interested	23	you and those who work with you will make a decision as
23	in between the EWL slab and the diaphragm wall should		to what it is, whether you need to consult with the
25	not be treated, according to the textbook, as part of	25	Buildings Department or not, and then you will proceed,
23	not be dedied, decording to the textbook, as part of	20	Bunanigs Deparation of not, and then you will proceed,
	Page 38		Page 40
1	Page 38	1	Page 40
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	Page 41		Page 43
1	MR CHOW: I'm going to move on pretty quickly. Sorry.	1	nominal threaded length of 44 millimetres is 26.4mm."
2	I just want to ask you one last question on this	2	A. Sorry, I'm just waiting for the words to come up, just
3	subject. If you look at the bottom of the page	3	so it would be easier for me to read them.
4	A. Can I just see the front page of this report, just so	4	Q. Page 49, the fourth paragraph from the top.
5	I can get it in context?	5	A. Okay. I could have written, "In my opinion, this
6	Q. Yes. The front page	6	therefore could become the acceptable standard for
7	COMMISSIONER HANSFORD: I think we are finding you a hard	7	a pass and fail", but, I mean, the whole report is
8	copy.	8	prefaced on the basis that it's my opinion.
9	MR CHOW: Yes. 8984.	9	Q. Understood. Yes. I just wanted to clarify, because
10	A. I think I've got that somewhere, yes.	10	I thought that is what you actually mean. Right. Thank
11	Q. If I can refer you to page 9012. Under	11	you.
12	paragraph 3.2.2.1, Atkins confirm that:	12	In section 15.6, here you refer to the fact that the
13	"Diaphragm walls and barrettes are employed as the	13	yield strength of the reinforcement used on site was
14	foundation system."	14	higher than the assumed 460 megapascals, and you
15	But I only have one question for you: would that	15	therefore suggest that we may perhaps have a further
16	make you change your view as to whether that part of the	16	8 per cent reserve in the capacity of the section. Do
17	diaphragm wall should be considered as superstructure?	17	you recall that?
18	A. Well, I think I would say that statement written is not	18	A. Yes.
19	true.	19	Q. In the various steel reinforcement testing reports, we
20	Q. All right.	20	notice that there are some reports that show actually
21	A. Because it says the second sentence says:	21	the reinforcing bars used did not have 500MPa. I just
22	"Both will have a nominal embedment	22	want you to take a look to see whether you have the same
23	(300 millimetres) into acceptable rock."	23	interpretation.
24	Now, as I understand it, the diaphragm walls are	24	Bundle B5, TS35254, please.
25	constructed on a hit-and-miss basis, so every third	25	Yes. First of all, on top of the page, right-hand
	Page 42		Page 44
1	•	1	Jan Star Star Star Star Star Star Star Star
1 2	Page 42 panel goes into the rock but the other two panels are founded at a level much higher, so therefore that	1 2	Page 44 side, it's stated, the fourth item, you see that on the right-hand side, "Grade of steel" is indicated to be
	panel goes into the rock but the other two panels are		side, it's stated, the fourth item, you see that on the
2	panel goes into the rock but the other two panels are founded at a level much higher, so therefore that	2	side, it's stated, the fourth item, you see that on the right-hand side, "Grade of steel" is indicated to be
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	Page 45		Page 47
1	reports, so that's why I wanted to show it to you, to	1	MR SHIEH: Before we rise, perhaps some references for the
2	see whether you have any further input on that.	2	Commission to consider in its spare time. It's as good
3	Another test report, at page TS35375 we may have	3	as any for me to raise it.
4	the same problem here because honestly I haven't noticed	4	CHAIRMAN: Yes.
5	this but I just want to make sure these are again	5	MR SHIEH: Just now, there was a reference to earlier
6	A. These are T16 bars.	6	references in the evidence to A shape or tapered. Can
7	Q. So that would not affect your opinion; right? So we can	7	I just give the Commission the evidential reference to
8	still safely allow for another	8	when it was raised previously in the course of evidence?
9	A. Not on the basis of this.	9	CHAIRMAN: Thank you.
10	Q. Okay.	10	MR SHIEH: The first time it was raised, not surprisingly
11	A. Clearly the person to ask is the stockist and the	11	not in the witness statement, is in Mr Poon's testimony
12	manufacturer.	12	on Day 7, page 142.
13	But, I mean, I asked Leighton it was a question	13	MR PENNICOTT: To 144.
14	that I asked them "Can you tell me what grade of	14	MR SHIEH: Mr Pennicott has found it.
15	steel?", and they responded to me, "We used grade 500."	15	MR PENNICOTT: I just checked.
16	Grade 500 was used. But, I mean, I don't have any	16	MR SHIEH: Page 142, line 19 to page 144, all the way to the
17	certificates or evidence of that. I just took that at	17	end of 144.
18	their words. So	18	MR PENNICOTT: Yes.
19	COMMISSIONER HANSFORD: I'm sorry, I don't wish to	19	MR SHIEH: Then it was picked up by the government in
20	interrupt.	20	cross-examination: Day 11, page 94, line 15, all the way
21	A. No, it's okay, please.	21	down to page 102, line 25. Those are the areas I could
22	COMMISSIONER HANSFORD: This is an interesting area for me	22	locate
23	and this has come up earlier in these proceedings, that	23	CHAIRMAN: Thank you.
24	we don't know whether we are dealing with 460 or 500,	24	MR SHIEH: where the issue about A shape or tapered
25	and my understanding is there was a point in time when	25	diaphragm wall was mentioned. Maybe Mr Pennicott has
	Page 46		Page 48
1	Page 46 the market changed from 460 to 500. But what I had not	1	Page 48 located
1 2	•	1 2	
	the market changed from 460 to 500. But what I had not		located
2	the market changed from 460 to 500. But what I had not appreciated, and perhaps I'm still not sure, is as to	2	located MR PENNICOTT: I have one further one. On Day 24, page 39,
2 3	the market changed from 460 to 500. But what I had not appreciated, and perhaps I'm still not sure, is as to whether it changed for all diameters at the same time or	2 3	located MR PENNICOTT: I have one further one. On Day 24, page 39, when Mr Chow was cross-examining Mr Buckland of Leighton
2 3 4	the market changed from 460 to 500. But what I had not appreciated, and perhaps I'm still not sure, is as to whether it changed for all diameters at the same time or whether T12s and T16 were still at one grade and T40s	2 3 4	located MR PENNICOTT: I have one further one. On Day 24, page 39, when Mr Chow was cross-examining Mr Buckland of Leighton regarding the A shape, evidence given by Mr Poon.
2 3 4 5	the market changed from 460 to 500. But what I had not appreciated, and perhaps I'm still not sure, is as to whether it changed for all diameters at the same time or whether T12s and T16 were still at one grade and T40s T50s at another. Do you have any knowledge of that?	2 3 4 5	located MR PENNICOTT: I have one further one. On Day 24, page 39, when Mr Chow was cross-examining Mr Buckland of Leighton regarding the A shape, evidence given by Mr Poon. MR CHOW: Thank you.
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	Page 49		Page 51
1	In terms of the general shape of this variation of	1	referring to?
2	bending moment, is that what you expected as well?	2	A. Yes.
3	A. Yes. For the top slab I mean, in the D-wall, it very	3	COMMISSIONER HANSFORD: So we've got a method where the top
		4	slab is constructed and then excavation takes place
4	much depends on the moments that are built up in the	5	underneath it?
5	D-wall during construction. So I can't recall exactly.	6	A. Yes.
6	But there are reports that have all the D-wall bending moment diagrams in them quite clearly. But this looks	7	COMMISSIONER HANSFORD: In fact Prof McQuillan shows that
7	• • •	8	sequence and I'm sure we will come to that when we
8	about right, yes.	9	ultimately get to him, probably tomorrow.
9	Q. For the benefit of a layperson, what we see the blue	10	
10	line here represents is for the blue line above the		A. It may be the manner in which it's put together is most
11	EWL slab, it shows that there is a hogging bending	11 12	easily explained by a bridge, a simply supported span
12	moment; is that right?	12	bridge. When that bridge is built, it's a simply supported span, but sometimes bridges are then made
13	A. Correct, yes.		
14	Q. The blue line for the region where the blue line is	14	continuous with the next-door span. COMMISSIONER HANSFORD: Yes.
15	under the EWL slab, it represents that the moment there	15	
16	is a sagging moment, in other words in another	16	A. In that case, the bending moment diagram is very
17	direction?	17	different compared to if you built two spans together at
18	A. Correct.	18	the same time.
19	Q. What I am interested in is the location where we have	19	COMMISSIONER HANSFORD: Yes. Thank you. That's helpful.
20	the bending moment equal to zero, that is the location	20	MR CHOW: The matter that I would like you to help me with
21	where bending moment inside the EWL slab starts to	21	is to understand the answer that we received from COWI
22	change direction.	22	last night. I'm not sure you've had a chance to read it.
23	I myself just tried to scale it off. The location	23	
24	is about one-fifth of the span of the EWL slab. Does it	24	A. I've not seen it, no.
25	appear to you to be roughly proper, in order?	25	Q. It has been inserted into the bundle. I believe it's
	Page 50		Page 52
1	A. I couldn't say. You're talking about the point of	1	tab 4.1 or 4.2.
2	contraflexure.	2	MR PENNICOTT: 4.5.
3	Q. Yes.	3	MR CHOW: 4.5, sorry. Thank you.
4	A. And this is a schematic diagram. I'm sure it's not	4	This is the answer that we received last night.
5	plotted based on real values. We'd have to go and look	5	I would like you to look at question 2. Perhaps if you
6	in the Atkins report to see exactly where the point of	6	would like to take some time to read question 2 and the
7	contraflexure was. But perhaps in a typical beam,	7	answer provided by COWI.
8	one-fifth in or whatever might be a point of	8	A. Okay. Move up.
9	contraflexure.	9	Q. Thank you.
10	Q. Of course I know the exact location would depend on the	10	A. Sorry, "move down" I suppose.
11	loading, depend on the structure and the size of member.	11	Can you just move up can I read the question
12	A. Yes.	12	again, please?
13	Q. I fully accept that. But as a general phenomenon, the	13	Okay. I've think I've understood that.
14	location, although it varies, would be within a certain	14	Q. Mr Southward, perhaps I will give you some background
15	range; would you accept?	15	information first. The reason why we asked question 2
16	A. It can vary. The point of contraflexure, it can vary	16	is because it is agreed between all the experts that at
17	widely depending on the loading applied to the frame.	17	the connection between the EWL slab and the diaphragm
18	It really can. And also how the structure was built.	18	wall actually experienced hogging moment, and that's the
19	So the manner in which the structure was put	19	reason why the experts agree that the bottom steel is
20	together, because the manner in which it was put	20	subject to compression.
1	together affects the shape of the bending moment	21	A. Yes.
21	together arrests are shape of the centering moment		
	diagram.	22	Q. This is also part of your view. So we would expect
21	diagram. COMMISSIONER HANSFORD: When you say "manner put together",	22 23	Q. This is also part of your view. So we would expect hogging moment to appear along the top of the east
21 22	diagram.		

	Page 53		Page 55
1	result shows all along the east diaphragm wall, the top	1	much, much larger than any of the other loads that are
2	of the east diaphragm wall, there is a sagging moment,	2	applied to the slab itself. So that hogging moment
3	and that's why it appears to the government as something	3	dominates.
4	that needs to be explained, and that's why we raised the	4	Now, onto that hogging moment, you have to add the
5	question.	5	bending moment diagrams from all the other different
6	Now, we received the answer from COWI last night.	6	load case situations. So maybe one of those load case
7	The way I understand it is what COWI tells us is, yes,	7	situations creates a sagging moment. Maybe temperature
8	at the centre line of the diaphragm wall, the moment was	8	or I don't know, because I haven't studied it in
8 9	a hogging moment, but as soon as we move outside, up to	9	depth. But I can see a scenario in which case a single
10	the interface, we are talking about 600 millimetres of	10	loading case exhibits what you said, but that's not the
10	distance away from the centre line, theoretical support.	11	same as the final design moment.
11	The hogging moment becomes sagging moment.	12	COMMISSIONER HANSFORD: So are you saying that with one
12			particular loading case there may be a sagging moment,
13 14	So we are talking about the change of bending moment	14	but that's counteracted by the hogging moments from
14 15	within a very short distance. The reason why I need to borrow Prof McQuillan's	14	other load cases?
15 16	bending moment diagram is to try to understand whether	15	A. Yes. Maybe can I draw?
16	it is reasonable. Now, according to Prof McQuillan's	17	COMMISSIONER HANSFORD: Yes, please. That would be quite
17	bending moment diagram, the point of zero moment	18	useful.
18	should I take your point that it may vary but	19	A. If you don't mind. A new page.
20	generally would be at 20 per cent or 15 per cent away	20	(Drawing with a black marker) The Plaxis run models
20		20	the slab at the two joints, the two slabs, and there are
21	20 per cent or 15 per cent of the span away from the	21	some struts; I think there's a diagonal strut in there
22	support. But in this particular case, according to COWI's	22	as well. So it models the whole building
23 24	But in this particular case, according to COWI's	23	COMMISSIONER HANSFORD: There's a diagonal strut during the
24 25	analysis, we are talking about 600 millimetres away from the support for a gran of 25 metros. In other words	24	temporary work?
23	the support, for a span of 25 metres. In other words,	25	
	Page 54		Page 56
1	the point where the moment starts to change, it's even	1	A. During construction, yes. I think there's a strut.
2	closer than 600mm.	2	COMMISSIONER HANSFORD: Again, I think Prof McQuillan shows
3	Now, I am not an expert but I am instructed by those	3	that in his sort of sequence of construction which we
4	who know this matter that there must be something wrong		will come to tomorrow.
5	with the analysis, and I want to hear what is your	5	A. So the Plaxis run models the whole life of the structure
6	reaction to that.	6	during the construction stage and it ends up with
7	A. Okay. So you said a loading case, so that would mean	7	a bending moment diagram, and I have to say, where it
8	that would indicate that it's a loading case.	8	goes down here (indicating), I'm not sure. Maybe it
9	Q. Yes.	9	does that (drawing a curving line), that kind of shape.
10	A. You have loading cases and then you go to load	10	But the big thing is that up at the top of the wall,
11	combinations, and the load combination is the one that	11	there's a significant hogging moment, which means that
12	we designed for.	12	in the slab there's a significant hogging moment like
13	So I don't know which loading case it is, but if you	13	that (drawing with a black marker). So that's very
14	put load onto a structure in isolation from any other	14	large.
15	load, then you might have a case that the sagging moment		And maybe the order of magnitude of that bending
16	goes all the way to the end of all the way to the	16	moment from the Plaxis run is maybe 70 per cent, I'm
17	walls. Like what? What example would that be? Maybe	17	guessing, 80 per cent, that kind of number, maybe. But
18	the live load or one discrete case might have	18	it's large.
19	a bending moment diagram that goes all the way to the	19	Then you might have another loading case that you
20	end, but these diaphragm walls are the analysis, so	20	have to consider, and because of the way the load is,
21	far as I've understood everyone's done, everyone's done	21	maybe a particular train over here (indicating) causes
22	a Plaxis analysis, which is a geotechnical software, and	22	that kind of shape (drawing with a red marker) with
23	that gives you the bending moments in the diaphragm	23	a very small transfer of moment around the corner.
24 25	wall. And the bending moment at the top of the diaphragm wall is a very large hogging moment, which is	24 25	But for design, we have to add these two together. So you add that to that (indicating), multiplied by

	Page 57		Page 59
1	various factors and things. But in this point here,	1	I just heard you had a discussion with Mr Chow on
2	it's that, and actually that's a minus, because it's	2	the photograph. I wish to invite you to assist me,
3	a different side.	3	actually, because I don't really know anything about
4	COMMISSIONER HANSFORD: That's what I meant by one	4	engineering. Can I trouble you to take a look at the
5	countering another; am I correct?	5	photograph that Mr Chow just showed you: B19/B25587.
6	A. Yes.	6	Just so you can help me, if I do not misunderstand
7	I don't know whether that is the case, but that	7	this photograph, the bars that are painted in blue
8	would be an explanation for that case.	8	colour, the area which is clouded in the red lines, are
9	MR CHOW: My last question, probably not a good question, in	9	actually the diaphragm wall; correct?
10	that particular load case, where the bending moment	10	A. Yes, I believe so. It looks like it, yes.
11	generated within the diaphragm wall manifests such	11	Q. Can the photograph be blown up a bit to the right of the
12	a sharp or quick change in bending moment within a very	12	diaphragm wall, those bars placed horizontally. If it
13	short distance, does this mean that the mid-span moment	13	could be even larger, please. Yes, thank you.
14	would be very large, in such circumstances?	14	Do we not see some lapping of the bars there?
15	A. Yes. In that case, it means the mid-span moment might	15	A. Yes, the bars that go across the top of the diaphragm
16	be larger, but it depends on the magnitude of the load	16	wall, in this area here, appear to be it seems to be
17	applied in the beginning.	17	a local area where there is some lapping, yes.
18	Q. Of course, yes. Would you recommend, in those	18	Q. But insofar as I understand, as you just explained to
19	circumstances, someone has to check whether the mid-span	19	this Commission in your figure 9 of your expert report,
20	is strong enough to resist that sort of a large bending	20	did you not say that the new design is one of
21	moment?	21	through-bars which there should be no lapping?
22	A. Sorry, can you say	22	A. Yes. I thought I explained: through-bars across the top
23	Q. The load case that we have looked at resulted in a very	23	of the diaphragm wall. I can't control this, can I, but
24	sharp change in bending moment, close to the support.	24	if we look at the bars
25	A. Yes.	25	COMMISSIONER HANSFORD: We can get a little hand on there
	Page 58		Page 60
1	Q. And you agree with me, in such circumstances, the	1	Page 60 for you, actually. We have that technology, I believe.
1 2		1 2	for you, actually. We have that technology, I believe. Is the hand coming? There we are.
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	Page 61		Page 63
1	A. What I'm saying is that some testing has been done, and	1	not go to structural integrity and just go to compliance
2	that testing demonstrates that the strength of the bar	2	with specification; is that your evidence?
3	coupler assembly is strong enough to meet the criteria	3	A. No. All those tests are all part of demonstrating that
4	of strength for the performance of the station	4	the coupler is satisfactory for use in any situation, in
5	structure.	5	any civil engineering application.
6	So that is a real it's a real thing. It's	6	Q. All right. Just to move on slightly it is at
7	something that we've actually seen. We've seen a test	7	page 132 then Prof Hansford asked you, in line 20:
8	and it's been tested and we know it's strong enough. So	8	"Sorry, Mr Southward so are you saying you don't
9	that's what I mean. If we have 60 per cent engagement,	9	believe elongation to be relevant to this project?"
10	that's what happens, so we know the structure is then	10	Your answer to be fair to you, you say:
11	safe.	11	" no. If you are looking at it from the point of
12	Q. And when you say "some tests", I understand that you are	12	view that I was, 'Is the structure safe?', then that's
13	referring to the CASTCO test that you have referred to	13	where I came from."
14	in page 48 of your expert report; correct?	14	That is the part which troubles me, Mr Southward.
15	A. Correct.	15	So are you saying that the permanent elongation test and
16	Q. Just so I don't misunderstand, that is also the only	16	the cyclic tension test has no contribution to
17	test, one and only one test, that you are now basing	17	structural safety?
18	this hypothesis on; correct?	18	A. Those tests are all part of a process of ensuring the
19	A. I believe there were five or six tests, but yes. The	19	quality of the product so that product can be used
20	results of those tests.	20	anywhere.
21	Q. All right. Just to make myself clear, when I say "one	21	Q. And the quality of the product certainly goes to
22	test", I mean just the static tension test; correct?	22	structural safety; correct?
23	That is five different tests based on the static tension	23	A. The quality of yes. I mean, structural safety is
24	test, one type of test?	24	when you have a functioning coupler, you then have
25	A. Yes.	25	structural safety, yes.
	Page 62		Page 64
1	Q. Right. I don't need to trouble you to go to the QSP,	1	Q. Good. So in order to have a full picture of whether the
2	but you certainly will understand that under the QSP,	2	coupler assembly is safe, you need all the three tests;
3	they stipulate more tests, not just one type of test;	3	correct?
4	correct?	4	A. Well, some tests have been done and they have
5	A. Correct.	5	Q. Don't tell me some tests have been done. There is just
6	Q. Those are the permanent elongation test and cyclic	6 7	one test done. Just the static tension test was done, is it not?
78	tension tests; correct? A. Correct.	8	A. Yes, and that is what is happening in real life out
9	Q. I wish to invite you to go to a discussion that you had	9	there. The station structure is there in a static
10	with my learned friend Mr Pennicott yesterday. It is in	10	arrangement, with a large load in the bars, now, as we
11	transcript Day 42, page 131, line 24.	11	speak. So that coupler assembly is under a static load.
12	There, when you were answering queries from	12	I think I also said that the future loading on this
13	Mr Pennicott, you were trying to say that:	13	coupler assembly is due to the trains, as the trains
14	"The testing of couplers to compliance to BD rules	14	move over the platform, and the stress in those bars is
15	is a kind of is a different thing. It's testing them	15	quite small.
16	with respect to the specification requirements, so that	16	So when you do the cyclic tension tests and you do
17	those couplers can be used in any situation anywhere."	17	the elongation tests, you are pulling the bar up to
18	Now, when you are talking about the testing of	18	0.6fy, which is a large load; 0.6 times 460 is, off the
19	couplers to compliance with the BD rules, you are	19	top of my head, 300.
20	mentioning those permanent elongation tests and cyclic	20	Q. I don't think we need to go to the rocket science of
21		21	those tests.
<i>2</i> 1	tension tests, were you?	21	those tests.
22	tension tests, were you? A. Yes.	22	A. Whereas the actual stress in the rebar due to the
22 23	A. Yes.Q. Insofar as so that I don't misunderstand your	22 23	A. Whereas the actual stress in the rebar due to the loading is maybe 15MPa, somewhere around that, of that
22	A. Yes.	22	A. Whereas the actual stress in the rebar due to the

	Page 65		Page 67
1	a static load. So we've got to test it statically to	1	just trains. And yes, trains are big and heavy but
2	make sure it can resist the applied static load, and	2	they're nothing compared to the weight of the slab, the
3	that's what those tests show.	3	3 metre thick slab, the span of the wall between the
4	Q. Let me try it another way. The station is now not yet	4	slabs. So everything is on a massive scale. So the
5	in use; correct?	5	loading on the bars is much larger now than any future
6	A. Correct.	6	train loading. Does that make sense?
7	Q. Your evidence, insofar as I understand, now the station	7	COMMISSIONER HANSFORD: It does. To me it does. Thank you
8	is static, the permanent elongation test and the cyclic	8	MR SO: So you are saying that as long as it passes the
9	tension test, at this stage, at this moment, does not	9	static tension test at this point in time
10	concern about structural safety; correct?	10	A. Please don't get me wrong. I'm not saying: don't do the
11	A. I don't think I'm saying that, no	11	cyclic test. I'm not saying that. I'm saying from my
12	Q. So what's your evidence?	12	perspective, and what I was engaged at, was to look at
13	A. What's my evidence? What do you mean?	13	the safety aspects, and I'm satisfied if the static
14	Q. Let me put it another way. In the current state, which	14	tension test can be met and that wouldn't be the case
15	is static, is it your evidence that the permanent	15	for every structure. I mean, I said yesterday about
16	elongation test and the cyclic tension test can shed no	16	a coupler at the base of the Nina Tower. I mean,
17	light whatsoever to structural safety of the station?	17	there the loading situation there is completely
18	A. I think all testing gives confidence in performance of	18	different, and there that coupler would experience large
19	things. That's why people do tests. So I'm not saying	19	reversals of force, and so other tests may be relevant,
20	that you shouldn't do testing. Testing is good.	20	or will be relevant, for that coupler. But that's
21	When I'm looking at the station, in this particular	21	a different situation to where we are now.
22	instance, with it being built, I know it's not open but	22	Q. All right. Can I bring you to the letter which BOSA
23	apparently trains have run across the slab, so it's	23	writes to the Buildings Department. That is in
24	experienced its design loading. There has been no sign	24	bundle H25, page H45858.
25	of reported distress. All the calculations indicate	25	COMMISSIONER HANSFORD: Sorry, Mr So, the date of that
	Page 66		Page 68
1	that there is a massive reserve of strength there, so	1	Page 68 letter?
1 2	that there is a massive reserve of strength there, so we've got to look at what is the most relevant test that	1 2	letter? MR SO: 7 January 2019.
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1	Page 69		Page 71
1	into the record. There it writes:	1	Then I would wish to draw your attention to the
2	"Regarding your question on how a partially engaged	2	first paragraph, then, of this page, the first line:
3	coupler would perform in permanent elongation test,	3	"In response to paragraph 2(b)(i) and (ii), please
4	static compression and tension tests and cyclic	4	note we do not have any test data on correlating partial
5	tension-and-compression tests, it is our opinion as	5	thread engagement of coupler to its structural
6	explained in paragraph 4 above, that it is unlikely that	6	performance. We have no intention in conducting such
7	such couplers, without being spliced butt-to-butt and	7	tests as it should serve no useful purpose for our
8	are therefore loose, will survive permanent elongation,	8	products."
9	and cyclic tension-and-compression tests."	9	Just to confirm, insofar as you are aware, before
10	Mr Southward, correct me if I am wrong, my	10	the tests conducted by CASTCO on 21 November 2018, were
11	understanding is insofar as you are aware, there were no	11	there any tests, either by BD or by Leighton or by MTR
12	static compression and tension permanent elongation	12	or by any sub-contractors, that have done tests as
13	test and cyclic tension-and-compression test being	13	regards to partial engagement of threads?
14	performed?	14	A. I'm not aware of any such tests.
15	A. I've not been made aware of those.	15	Q. We know that you are an expert in this field. Have you
16	Q. Are you able to give us expert opinion as to whether you	16	come across any situation where you would test partial
17	think BOSA is justified to say that it would be unlikely	17	engagement of threads into a coupler?
18	that it would survive those tests?	18	A. No, I mean, I've not had the need to test this situation
19	A. I don't think I am, and actually I note that these guys	19	before.
20	can't give their opinion because they just say	20	Q. Have you engaged in testing the strength of a coupler by
21	"unlikely". But, I don't know, I've not seen or	21	fully engaging the threads into it, in your past
22	witnessed a partially engaged test, so I can't tell you	22	experience?
23	whether or not it will fail or pass.	23	A. I've not personally seen any testing of these couplers.
24	Q. All right.	24	Q. In your past experience, not confined to this?
25	COMMISSIONER HANSFORD: Sorry, Mr Southward, aren't you	25	A. Yes, in my past experience, I've not seen or witnessed
	Page 70		Page 72
1	telling us that this situation of cyclic tension and	1	1
1		1	a coupler test.
2	compression, this reversal of load on this coupler, is	2	a coupler test. Q. All right.
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2		2	Q. All right.
2 3	not something that's going to occur in this situation?	2 3 4	Q. All right. CHAIRMAN: But surely, are you this is why I'm concerned
2 3 4	not something that's going to occur in this situation? A. Yes.	2 3 4	Q. All right.CHAIRMAN: But surely, are you this is why I'm concerned about this letter coming as it does "We have no
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	Page 73		Page 75
1	CHAIRMAN: He hasn't. No, he doesn't work for BOSA, but if	1	with partial engagement and the test results are shown
2	he does, he should have told us.	2	in the photo enclosed."
3	Are you employed by BOSA?	$\begin{vmatrix} 2\\ 3 \end{vmatrix}$	Now, Mr Southward, I just want to confirm, save and
4	A. I can confirm, I do not work for BOSA. I have no	4	except the set of data that you have received from
5	relationship with them.	5	CASTCO, did you receive another set of data from MTR?
6	CHAIRMAN: So effectively we are in a position where	-	A. No. I'm just reading the paragraph above. Here it
7	internationally recognised manufacturers of artefacts	6 7	
	for engineering will test them as is necessary to ensure		says:
8		8	"Nevertheless, in view of the issue of insufficient
9	not only that they stand up under correct application	9	engagement of threads wish to find out the tensile
10	but that they have tolerance levels outside of correct	10	strength of couplers with various degrees of partial
11	application. That must be the case, and I think that we	11	engagement and accordingly, we have provided such
12	as a Commission can take it that that is what will have	12	samples and conducted tensile strength tests on them and
13	happened with BOSA couplers.	13	representatives from BD were invited to [witness]
14	Now, was it done in this particular instance? Are	14	such tests."
15	they willing to now do it? Clearly not, not in terms of	15	So that implies that that sentence is about the
16	that letter.	16	CASTCO tests. Then it says:
17	MR SO: Of course, sir.	17	"We also understand MTR has conducted various
18	CHAIRMAN: All right? I don't mean to sound overly	18	similar tests."
19	aggressive but there are certain areas and that's why	19	I'm not aware of those various similar tests.
20	I'm concerned about this letter we have to be very	20	Q. Thank you very much. I just want to confirm that point,
21	careful when it's written and in that context it's	21	that you didn't receive other test results from MTR,
22	written.	22	just the CASTCO?
23	MR SO: Of course, sir.	23	A. Yes.
24	Mr Southward, then, as a matter of common sense,	24	Q. Thank you.
25	would you agree with me, and as a matter of practical	25	Now I want to move to another topic. Can I bring
	Page 74		Page 76
1	science, experiments and experimental results would	1	you to OU352.
2	vary?	2	Sorry, I understand there is a new addition this
3	A. Experimental results will vary? Yes, of course, they	3	morning. OU368.
4	do, yes.	4	I'm happy to use an old edition, if OU368 is not yet
5	Q. And although conducting in all the control factors	5	up. I'm happy to proceed with OU352. Let's move on.
6	being at hand, there would still be differentiations	6	Let's take a look at OU352.
7	between experimental results; would you agree with that?	7	Mr Southward, I'm sure that you are of course aware
8	A. I would agree with that, yes.	8	of the results of the opening-up?
9	Q. Of course, therefore, that's the reason why we have to	9	A. I've been receiving these documents, yes.
10	have more than one test being tested for each control	10	Q. Thank you. I want to draw your attention to a few of
11	set of variables; correct?	11	the test results. The first one I want to draw to your
12	A. Yes. Yes.	12	attention would be test 21. Can that be blown up a bit?
13	Q. Because it would be not reliable in that case, just to	13	Thank you.
14	rely on one of the experimental results that we have	14	A. Test 21, where is that?
15	obtained?	15	(Hand indicating on the screen)
16	A. Yes. As I said, I'm not an expert in statistics, so,	16	Q. Before we start, just to let us have a backdrop of what
17	you know, as to the number of tests, I can't comment.	17	is happening. I understand that it is BOSA's
18	Q. Thank you. I bring you back to the same paragraph. I'm		specification that the threaded length is 44 millimetres
19	not labouring the point that the Chairman has just	19	long; correct?
20	indicated. I just want to confirm one fact with you.	20	A. The threaded length is
21	It was five lines counting from the bottom of this	21	Q. 44 millimetres long.
22	paragraph. There it writes:	22	A. Plus up to 4mm extra.
23	"We also understand MTR has conducted various	23	Q. Correct. That 44 millimetres is what we call a positive
24	similar tests. So far as we are aware this is the	24	tolerance, so it is always about 44; it could not be 40.
25	single type of test that has been conducted on couplers	25	A. I understand, yes.

	Page 77		Page 79
1	Q. So the length must be 44 to 48 millimetres?	1	plus or minus 3 millimetres of that test. So that would
2	A. Correct.	2	not be just 4 millimetres, in my respectful submission.
3	Q. Let us have a look at test 21. We can see the	3	COMMISSIONER HANSFORD: Forgive me, Mr So. I think I wa
4	engagement length is 35.34 millimetres; correct?	4	just thinking out loud.
5	A. 21, 35.34, yes, I see that.	5	MR SO: Thank you, Professor.
6	Q. If we give the benefit of doubt of that 3 millimetres,	6	Let me just give another example. I wish to labour
7	plus or minus 3 millimetres, that would give us	7	this point. Can I go to test 48. This is another
8	38.34 millimetres; correct?	8	example. The engagement letter is 33.98 this time;
9	A. Yes.	9	right?
10	Q. And there are no exposed threads, so the maximum	10	A. 48, 33.98, yes.
11	possible total threaded length would be	11	Q. Giving the benefit of doubt again, the 3 millimetres,
12	38.34 millimetres?	12	that's 36.98, and again with no threads being exposed.
13	A. I really don't know, because that's a measurement that's	13	A. (Nodded head).
14	come out of this test, this phased array ultrasonic	14	Q. You are of course aware of these results.
15	testing thing. I don't know how that system really	15	I would then wish you to go to Prof McQuillan's
16	works, so whether that's the right number or not,	16	report, page 117. That's the agreed expert memorandum
17	I don't know.	17	signed on 18 December 2018.
18	Q. All right. Fair enough. But at least on the face of	18	A. Yes.
19	the results?	19	Q. I understand this is also one of the memoranda you have
20	A. On the face of it so it says zero threads exposed,	20	signed your name onto, which indicates that you agreed
21	but where you know, what does that mean? Does that	21	with the content of this agreement; correct?
22	mean that there is absolutely nothing and the bar is	22	A. Yes.
23	completely screwed on, or does it mean that the bar	23	Q. Of course, being an expert to this Commission, you are
24	there's a little bit of thread exposed or the start of	24	aware that you are allowed to change your evidence or
25	a thread?	25	change your opinion if you find it justified to do so;
	Page 78		Page 80
1	Page 78 Q. Of course. That's a fair comment.	1	Page 80 correct? You understand that is you are of course
1 2		1 2	-
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2 3	 Q. Of course. That's a fair comment. Let me give the benefit of doubt to that too. All right. There is a 2 millimetre thread there, as you said, one extra thread; that would give us 40.34 millimetres. That is still short of 	2 3	correct? You understand that is you are of course advised about that? A. Yes.
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	Page 81		Page 83
1	CHAIRMAN: It's just before 1 o'clock. Mr Boulding?	1	COMMISSIONER HANSFORD: Ah. Good.
2	MR BOULDING: I was just going to say that Dr Glover is	2	MR CHOW: And I've just received instructions that actually
3	available but I do see the hour and you may well think	3	the list has been served right before lunch.
4	it's worthwhile rising a few minutes early and giving	4	COMMISSIONER HANSFORD: The wonders of modern technology
5	him a clean start at 2.15.	5	Thank you.
6	CHAIRMAN: Yes. Good. So we will adjourn until 2.15, the	6	CHAIRMAN: Thank you. So long as it's being dealt with,
7	same time. Thank you.	7	because we appreciate Prof Au's concerns, and it may be,
8	(12.57 pm)	8	it may not be, our decision, once we've heard all the
9	(The luncheon adjournment)	9	evidence, that perhaps, in the interests of caution, if
10	(2.19 pm)	10	nothing else and we make no assessments of anything
11	MR BOULDING: Good afternoon, sir. Good afternoon,	11	at this stage
12	Professor.	12	MR CHOW: Understood.
13	CHAIRMAN: I do apologise. One second only. Thank you.	13	CHAIRMAN: that those tests or those calculations should
14	Mr Chow, I'm not suggesting that we will have to go	14	be conducted.
15	through the exercise yet, but at the end of his evidence	15	MR CHOW: Understood.
16	Prof Au had spoken of a series of mathematical	16	CHAIRMAN: Thank you very much, Mr Chow.
17	calculations that may assist him to be more certain or	17	Mr Boulding.
18	more satisfied, whatever the correct terminology is, as	18	MR BOULDING: Good afternoon, sir. Good afternoon,
19	to the safety issues.	19	Professor. As I promised, I am now going to call the
20	COMMISSIONER HANSFORD: More confident.	20	MTR's structural engineering expert, Dr Glover.
21	CHAIRMAN: "More confident" would be the word. I'm not	21	Dr Glover, good afternoon. Welcome to the
22	saying we necessarily have to embark upon them, but we	22	Commission.
23	would like to know what they would be; okay?	23	WITNESS: Thank you.
23	I understand that there are two different tranches:	24	
25	firstly, a set of mathematical calculations that should	25	
	· · · · · · · · · · · · · · · · · · ·	-	D 94
	Page 82		Page 84
1	be reasonably easy to conduct in a short time span; and	1	DR MIKE GLOVER (sworn)
2	secondly, as a fallback, in the case of real concern,	2	Examination-in-chief by MR BOULDING
3	certain tests okay?	3	MR BOULDING: So you have given your name to the learned
4	Let's leave the tests at the moment. What we are	4	Commissioners. Please give them your professional
5	more concerned with is an outline of those mathematical	5	address.
6	calculations, put together in a way that people who	6	A. Ove Arup & Partners, Hong Kong.
7	understand these things are able to deal with, so that	7	Q. You have prepared, have you not, a report for the
8	we can, if necessary, give directions as to those	8	Commissioners' assistance, and perhaps we can get that
9	mathematical calculations.	9	up ER1, tab 6 and look at the cover page.
10	MR CHOW: Yes. Sir, I am actually in a position to inform	10	A. That's correct.
11			1
12	the Commission that as far as I know, over the past few	11	Q. That's the first page of your report, 17 January.
	days, Prof Au has been working on this and we have got	11 12	Please go on to page 16. Do we there see your
13			Please go on to page 16. Do we there see your signature above the date of 7 January 2019?
13 14	days, Prof Au has been working on this and we have got	12	Please go on to page 16. Do we there see your signature above the date of 7 January 2019? A. That's correct.
	days, Prof Au has been working on this and we have got to a stage where the document is almost ready to be served. I understand that originally there was a deadline	12 13	Please go on to page 16. Do we there see your signature above the date of 7 January 2019?
14	days, Prof Au has been working on this and we have got to a stage where the document is almost ready to be served.I understand that originally there was a deadline imposed by the Commission which was, I believe,	12 13 14	Please go on to page 16. Do we there see your signature above the date of 7 January 2019? A. That's correct.
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1 Q. Do you still hold the views and agreed propositions 1 attending Prof Au's lectures on the same subject. I'm 2 which are signed off therein? 2 sorry for that little brief metridue but I think the 4 Q. So far as you are concerned, were all experts content to 4 So from the outset of ny carcer. I've had strong 6 A. Yes. 6 standards, and most of all the fundament inprotance in my carcer of two things: one is search and the other 7 Q. Right, Dr Glover. I understand i, you are going to give at post gene of the the standards, and most of all the fundament inprotance in my carcer of two things: one is search and development. I was throst 11 present a summary of your views. Is that the situation? 11 So, after research and development. I was throst 12 A. Tat is correct. 12 condinated in the design and construction of the Hads 13 Q. Over to you, Dr Glover. 14 Honglong and Shanghai Bank here in Hong Kong, and some of the research that we carcied out on tha was really quie ground breaking. Interestingly enough, that's 14 A. Good afternoon. My name is Mike Glover. I'n a fellow of 14 14 honglong and Shanghai Bank here in Hong Kong, and some of the research that we carcied out on tha was really quie ground breaking. Interestingly enough, that's 15 reflow in 20.6 is recogniting is in Zows Si refraw 10		Page 85		Page 87
2 which are signed off therein? 2 sorry for that little brief interlude but 1 thit the 3 A. 1do. 0. So far as you are concerned, were all experts content to 5 sign that joint menorandum? 5 6 A. Yes. 6 So from the outset of my career. I've had a stong 7 Q. Right. Dr Glover. 7 0 Right. Dr Glover. 7 10 then, as I understand you have pepared. 7 ore is development. You will find that in practically 9 are going to tell us a little bit dbout yourself, and 9 every project I've done. There's always a degree of 10 then, as I understand you have pepared. 70 research and development. I was thust 12 A. That is correct. 12 into the world of high-tech architecure, which. 13 Q. Over to you. Dr Glover. 13 cultimated in the design and construction of the highest design and 16 the Institution of Structural Engineers and a Roup 14 Iongkong and Shanghai Bank here in Hong Kong, and Sone of the high engineers in Prosent. 16 the Institution of Structural Engineers in 2008 14 wheres L linsta inidiate in the wearall of a very, very extemsive, H	1	Q. Do you still hold the views and agreed propositions	1	attending Prof Au's lectures on the same subject. I'm
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	Page 89		Page 91
1	you've got before you now is BOSA have done some	1	way, at 230 kilometres per hour, so that can burst the
2	calculations, there's an indication that it could be	2	ears if you are not watching out, so we've got lots of
3	successful, there have been some limited tests carried	3	vent shafts.
4	out, but they are not detracting from the course of	4	All I'm trying to get across to you is that this is
5	direction. And as I will give in my presentation later,	5	sheer excitement of engineering; that's what matters to
6	MTR are about to embark upon a full-scale test which	6	me.
7	will satisfy the criteria of the specifications which	7	Then as soon as I finished that, I found myself
8	are set down by various organisations, and I think that	8	being the technical director for the client for let's
9	will bring a full stop to that issue.	9	call it the third Forth Bridge in Scotland, which I'm
10	For those doubting Thomases in the audience, yes, it	10	very proud of it, and I'll come on to why I'm very proud
11	will involve what I think is being called elongation or	11	of it a little bit later. Again I took that right
12	something yes, elongation and I will go into that	12	through from inception, took it through the
13	a little bit more in my presentation.	13	parliamentary process, in select committees, and right
14	So I make those statements at the outset because	14	the way through to it getting opened, and that is
15	they seem to be recurring concerns, so I just wanted to	15	substantially under budget.
16	pick up on those as we went.	16	With projects like that, I think you will get
17	After the Hongkong Bank, I decided I wanted a change		a feeling for the emotion and passion I show for what it
18	from buildings, particularly working with high-signature	18	is, that the things I do are hands-on. I'm a doer, not
19	architects in that sense, so I did some prime agency	19	a watcher. I think that's a very important property
20	work in the oil and gas industry, and we came up with	20	to have in an individual.
20	prototype concrete gravity platforms for the North Sea	20	As to my remit today, to be clear, I've been
21	and we built quite a number of them around the world,	21	appointed by MTR to present expert evidence to the
22	and I enjoyed that very much, and I enjoyed the prime	22	Commission on structural engineering matters, and on
23 24	agency issue, really, the design and taking it through	23 24	such evidence I am completely independent, and my sole
24	to construction. In other words, having the actual idea	24 25	objective is to assist you, the Commission, in its
23		23	
	Page 90		Page 92
1	and then actually making it. I always find the design	1	
			deliberations.
2	process, it's only a means to an end, and people who	2	I think that's enough about me, so I'd like to start
3	process, it's only a means to an end, and people who spend their whole life just thinking about design, they	2 3	I think that's enough about me, so I'd like to start the presentation, really, in that sense.
3 4	process, it's only a means to an end, and people who spend their whole life just thinking about design, they have missed something. That's what it is, it is that	2 3 4	I think that's enough about me, so I'd like to start the presentation, really, in that sense. CHAIRMAN: Yes, of course.
3 4 5	process, it's only a means to an end, and people who spend their whole life just thinking about design, they have missed something. That's what it is, it is that continuous thinking process which is important in what	2 3 4 5	I think that's enough about me, so I'd like to start the presentation, really, in that sense. CHAIRMAN: Yes, of course. A. Before I actually start the presentation proper, I would
3 4 5 6	process, it's only a means to an end, and people who spend their whole life just thinking about design, they have missed something. That's what it is, it is that continuous thinking process which is important in what you do.	2 3 4 5 6	I think that's enough about me, so I'd like to start the presentation, really, in that sense. CHAIRMAN: Yes, of course. A. Before I actually start the presentation proper, I would like to share with you some lessons or some particular
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3 4 5 6 7 8 9	process, it's only a means to an end, and people who spend their whole life just thinking about design, they have missed something. That's what it is, it is that continuous thinking process which is important in what you do. But then I got whisked away to be the technical director and the deputy project director for HS1, the first high-speed railway in the UK. I was effectively	2 3 4 5 6 7 8 9	I think that's enough about me, so I'd like to start the presentation, really, in that sense. CHAIRMAN: Yes, of course. A. Before I actually start the presentation proper, I would like to share with you some lessons or some particular lessons I've learnt from my experience, and I think they are poignant. They might be at slightly left-field but I feel I want to say them, because I do have
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23 (Pages 89 to 92)

1	Is it the same bridge? Well, no, it can't be the same	1	My report and this presentation are looking at the
2	bridge, it's just more beautiful. But there are things	2	design and construction on a strictly
3	you do right at the outset which become so important.	3	fitness-for-purpose basis. I'm not seeking to
4	Some of them might be a little too near the bone for	4	demonstrate compliance. I'm just trying to demonstrate
5	this audience so I will just pick on some of them. Some	5	safety, on the basis of fundamental physics and
6	of them were very innovative engineering. Maybe you	6	experience.
7	would expect that from Arup, but actually it comes from	7	The first thing I would say, that ho hum sorry,
8	a freedom of thought, not crushing things. It's	8	Hung Hom. I'm sorry, I nearly broke into song there.
9	fundamentally creating a single focus on delivering the	9	I didn't mean to. It could be a good one, couldn't it?
10	project for whoever is involved in the project.	10	CHAIRMAN: That's a very interesting malapropism.
11	COMMISSIONER HANSFORD: Sorry, did you say not crushing	11	A. It's a very unusual structure and I've not heard people
12	things?	12	referring to it as being unusual. People just look at
13	A. I'll just elaborate on that.	13	problems and things but I look at it as a structure.
14	COMMISSIONER HANSFORD: Okay.	14	It's quite unusual for a number of characteristics and
15	A. It is crushing, yes.	15	I'll try to pick out a few of those as we go through.
16	COMMISSIONER HANSFORD: That's fine. Thank you.	16	But I think some of the issues you've been
17	A. You've got to get people I call it the flag on the	17	confronted with are a direct product of that. There's
18	hill you've got to get every member of the team	18	a danger of always looking at construction and saying
19	and the team is not just the people who are the	19	there's this in construction, but it's not. It has its
20	designers or the specifiers. They are the approvers,	20	roots right the way back in its concept, right the way
21	they are the third parties, they are the community;	21	through its design, and all you're seeing is the end,
22	you've got to get everybody it's hard work, but when	22	the result of that process.
23	you do that, you've got everybody aligned. Everybody	23	With that as the backcloth, maybe I could go to the
24	can see the flag on the hill. There's no them and us.	24	slides.
25	It's them and us that costs you money in projects, but	25	MR PENNICOTT: On the screen.
	Page 94		Page 96
			I uge > 0
1		1	
1	if everybody is rooting for that objective, it's quite	1	A. Do I just say "next slide"?
2	remarkable how the pounds, or in this case the Hong Kong	2	Next slide, please. I haven't done this for ages,
2 3	remarkable how the pounds, or in this case the Hong Kong dollars, fall away.	2 3	Next slide, please. I haven't done this for ages, saying "next slide". It's quite refreshing; I'll have
2 3 4	remarkable how the pounds, or in this case the Hong Kong dollars, fall away. So that's fundamentally important, but one of the	2 3 4	Next slide, please. I haven't done this for ages, saying "next slide". It's quite refreshing; I'll have to try to think about this.
2 3 4 5	remarkable how the pounds, or in this case the Hong Kong dollars, fall away. So that's fundamentally important, but one of the subsets of that is that you must challenge compliance	2 3 4 5	Next slide, please. I haven't done this for ages, saying "next slide". It's quite refreshing; I'll have to try to think about this. I'll deal with the project by going through a whole
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1	Page 97		Page 99
1	the sort of detailing that you are seeing in that	1	trouble with so I try to keep the scale.
2	particular clause, 9.9.1.1, is the sort of detail we	2	So that's appropriate. Under normal loading, you
3	would use in real seismic areas, and Hong Kong is not	3	would want there to be no permanent deformation.
4	a high seismic area. And the reason why you have those	4	Take the case where you have a very strong ground
5	particular details is because you get what we call	5	motion from an earthquake. There you want survivability
6	stress reversals. In heavy ground shaking, things move	6	of the occupants, so therefore you can accept permanent
7	backwards and forwards, so something that was in tension	7	deformation. Some of it, if it's a small amount, it
8	becomes compression so you get that action	8	could be recovered and you can use the building again,
9	(demonstrating with hands).	9	but normally it would be demolition.
10	Well, that won't happen in Hong Kong and it most	10	On the next slide, hopefully yes, here we are
11	certainly won't happen with a rigid box sitting in the	11	the codes talk about critical zones, plastic zones, and
12	ground. So I think there seems to be a slight	12	these are shaded on the top diagram, and these are where
13	misapprehension as to how to apply that particular	13	these plastic hinges occur, which allows the structure
14	clause to this type of construction. That's my opinion.	14	to sway, as shown as the bottom.
15	Could we go to the next slide, please. I just	15	If you go to the next slide, you will see that's not
16	wanted to explain to people what ductility is, and this	16	what we've got. We've got a really substantial stiff
17	is going to be difficult without a pointer but I'll try	17	box, which actually, if there is and the earthquakes
18	my best.	18	you get in Hong Kong will tend not to be of long
19	COMMISSIONER HANSFORD: You can get a pointer because the	e 19	duration or they will be high energy but they tend to
20	operator can put a little hand on.	20	be in the high frequency areas so the box is really
21	A. Could you take it up to where the 560 is and where it	21	held very steady, and the ground would dampen any large
22	links across to the yellow. That's it. That's what we	22	movements.
23	would call the notional yield point. If you loaded	23	This is the experience around the world. Box
24	something from zero, it would go up to about the 560 and	24	structures have survived very, very heavy ground
25	then it would follow the line back again when you took	25	movement, remaining effectively in their elastic zone.
	Page 98		Page 100
1	the load off. That's what we call elastic. So you load	1	It's because
2	it on and it comes back.	2	COMMISSIONER HANSFORD: Where, for example?
3	We say that's recoverable shortening or deflection.	3	A. California, for example. I don't have experience of
4	So that's the elastic zone.	4	Japan so I'm not going to go that far. Japan is very,
5	If you then take the pointer from that point and	5	very seismic, much more seismic than California, for
6	move it to the right there it goes; keep going, right	6	example.
7	to the end where the pointer is going is the plastic	7	So assuming a box like that is seismically sensitive
8	portion of the curve, and ductility really is the ratio	8	
9			in an environment like Hong Kong is not correct.
1	between the elastic portion and the ductile portion, and	9	But I'll use that particular slide to explain some
10	this one, looking here, it's probably a ductility ratio	9 10	But I'll use that particular slide to explain some of the reasons why I say this construction is a little
	this one, looking here, it's probably a ductility ratio of five. In other words, you can get five times the	10 11	But I'll use that particular slide to explain some of the reasons why I say this construction is a little bit different. It is because if you see the arrow that
10 11 12	this one, looking here, it's probably a ductility ratio of five. In other words, you can get five times the energy absorption out of a plastic zone than you do out	10 11 12	But I'll use that particular slide to explain some of the reasons why I say this construction is a little bit different. It is because if you see the arrow that says "EWL slab" well, that slab is 3 metres thick,
10 11 12 13	this one, looking here, it's probably a ductility ratio of five. In other words, you can get five times the energy absorption out of a plastic zone than you do out of the elastic.	10 11 12 13	But I'll use that particular slide to explain some of the reasons why I say this construction is a little bit different. It is because if you see the arrow that says "EWL slab" well, that slab is 3 metres thick, and that's very, very exceptional for a suspended
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	Page 101		Page 103
1	to use mass. And so therefore we have to find something	1	COMMISSIONER HANSFORD: Albeit quite a thin one.
2	equivalent to 5 metres of mass in the construction to	2	A. That one looks thin but there are some more substantial.
3	keep the water down. The way that is done is a 3 metre	3	COMMISSIONER HANSFORD: Okay.
4	slab at EWL level and a 2 metre slab at NSL level.	4	A. You've got to remember, when you build something into
5	COMMISSIONER HANSFORD: Why that way around?	5	something that's already there, there are locked-in
6	A. This was a design decision, as I understand it, and it	6	stresses and locked-in deflection. I wouldn't want to
7	was that there was sufficient headroom between the NSL	7	alarm you. I mean, a 3 metre slab spanning something
8	level trains and the EWL that they could use that depth.	8	less than 24 metres is more like an arch it's going
9	If they had done it the other way around, we would	9	to turn into a lecture, I've got to watch out but
10	have had to go deeper, because a lot of people don't	10	that's one of the other issues about robustness. People
11	realise this but trains don't just go up and down hills,	11	normally and I think Prof Au used the term
12	they have very controlled gradients and so the line the	12	a catenary, you know, you with a thin slab, it
13	trains come in on the NSL, that's the level it has to	13	certainly would go into a catenary and that's what it
14	be, within a few metres.	14	is. But a structure like this, the fire the
15	COMMISSIONER HANSFORD: I see.	15	structure expands and really it tends to arch. You
16	A. So really the decision to put the 3 metre slab there,	16	know, it can
17	although it is extremely unusual, the engineering	17	COMMISSIONER HANSFORD: Perhaps colleagues will excuse my
18	justification for it is very, very sound and very solid,	18	enthusiasm for this but I'm rather interested.
19	and interestingly enough, even although I had shock	19	A. Well, that's the way the structure works. And believe
20	horror of seeing it in the first place I can	20	me, this structure's got plenty of I use the
21	understand the logic of it and I wouldn't contest that	21	definition very appropriately here it's got plenty of
22	idea.	22	robustness; it's not going anywhere.
23	But it does generate its own issues, and some of	23	So I thought, to give some context to some of the
24	them very positive, actually.	24	issues, it would be worth just explaining some of that
25	So that's what makes this one particularly special,	25	to you.
	Page 102		Page 104
	1480 102		Page 104
1	the geometry.	1	If I could move on to the next slide now and talk
1 2	the geometry.	1 2	If I could move on to the next slide now and talk
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2	the geometry.	2	If I could move on to the next slide now and talk about seismicity. I just want to I won't spend so
2 3	the geometry. The second thing that makes it very interesting and this is why a lot of people are saying they don't	2 3	If I could move on to the next slide now and talk about seismicity. I just want to I won't spend so much time on this one, because nobody is contesting the
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2 3 4 5	the geometry. The second thing that makes it very interesting and this is why a lot of people are saying they don't believe the utilisation values that are being talked about is it's a structure which has two lives. The	2 3 4 5	If I could move on to the next slide now and talk about seismicity. I just want to I won't spend so much time on this one, because nobody is contesting the fact it's a low to moderate seismicity. The Hong Kong Code doesn't even have a chapter on it. MTR in their
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	Page 105		Page 107
1	a lot more than the other, but they are not serving	1	them are distressingly high. I'm a great believer in
2	a function of ductility.	2	not having exception solution designs, in other words
3	The other important thing is because of its sheer	3	don't design for the maximum. You've got to design for
4	mass and because of the fact that it sits in this box,	4	something lower than that and deal with the maximums.
5	it means that it doesn't undergo stress reversals, as	5	But there are no maximums that I've found or that Atkins
6	I was saying about the things (demonstrating with	6	have drawn to our attention that would cause alarm in
7	hands); it only knows about either direct tension or	7	this structure.
8	direct compression.	8	COMMISSIONER HANSFORD: The reason you say you are a great
9	The other thing to emphasise is that the base, the	9	believer in not designing for the maximums, Dr Glover,
10	bottom of the slab, as it joins the wall, is permanently	10	is because presumably, if you design for the maximum,
11	in compression. With all due respect to Mr Chow	11	you are always overdesigning and it costs a lot more?
12	earlier, the idea of there being a sagging moment to the	12	A. It costs a lot more. It costs a lot more time. There
13	support, I hope that you understood what we were saying	13	is a lot more that can go wrong. I've always tried to
14	about load combinations. That particular I think	14	bring my team up with the attitude of do the simple
15	it's called PERM 5 it never exists as an individual	15	things simply to buy time for those things that we know
16	situation. It's only a component. And if necessary, if	16	we're going to deal with, otherwise you are just caught
17	you wanted me to, in discussion, I could explain	17	out, you know. The other thing you really are
18	a little bit more, but it never goes into sagging and	18	starting me off now you've got to do at the outset of
19	indeed Prof McQuillan's diagram, you should stay with	19	any project, you've got to be very honest about what you
20	that as your knowledge base, I think.	20	don't know. If I was to think about what the most
21	So if I have the next slide, I think, please. Oh,	21	important thing about starting a project is you sit down
22	that's the calculation which I apologise for, so we can	22	with your key team and say, "What don't we know?",
23	skate over that.	23	because those are the things you've got to embark upon
24	COMMISSIONER HANSFORD: You are only apologising for your	24	your research programme then.
25	handwriting, are you?	25	So often you see with projects people bump into
	Page 106		Page 108
1	A. No. I'm not trying to hide any errors on that. I'll	1	something later on and it's too late. You know? I'm
2	take you through it if you want me to. Are you sure?	2	not going to say I'm infallible, please don't take it as
3	I'm quite happy to.	3	that, because that's the quality of the team, no
4	COMMISSIONER HANSFORD: I made the point yesterday that	4	individual is strong enough to know everything. But if
5	I think it's unwise for lawyers to get into structural	5	you've got the right team, and I don't just mean those
6	calculations.	6	people around you, but those people who positively think
7	A. I don't know, you may want to change career.	7	about the flag on the hill, then you rarely go wrong.
8	Could you go to the next slide.	8	Both ourselves have carried out spot-checks, as
9	You've heard a lot of strength utilisation and	9	Arups, and COWI's report I thought was condescending
10	basically it's the ratio between two numbers. One is:	10	slightly a good effort, but I thought it was
1			
11	what is the maximum strength of this component on the	11	well-conceived. They drew attention to 161 stress, as
12	what is the maximum strength of this component on the bottom, and on the top is, what is it actually being	12	well-conceived. They drew attention to 161 stress, as a good engineer would do, just innocently saying it's
12 13	what is the maximum strength of this component on the bottom, and on the top is, what is it actually being stressed to at the moment? It's just a simple ratio.	12 13	well-conceived. They drew attention to 161 stress, as a good engineer would do, just innocently saying it's a boundary condition and suddenly a bonfire is lit.
12 13 14	what is the maximum strength of this component on the bottom, and on the top is, what is it actually being stressed to at the moment? It's just a simple ratio. And it's a measure, obviously, of how hard the structure	12 13 14	well-conceived. They drew attention to 161 stress, as a good engineer would do, just innocently saying it's a boundary condition and suddenly a bonfire is lit. But, no, I fully understand the way it was modelled
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1	Page 109		Page 111
1	A. That's for pouring the concrete.	1	prudence. The other reason is that they have had some
2	COMMISSIONER HANSFORD: Okay.	2	bad experiences in the past, but I think those bad
3	A. You put interestingly enough, when you look at	3	experiences are not to do with the soil parameters, they
4	a modern diaphragm wall, you think it's a piece of	4	are to do with contractors not putting props in at the
5	scientific investigation. It is, in fact, because we	5	right time. But there we are. But don't start me on
6	put tubes in for inclinometers, let's call it	6	that issue. I will move on.
7	a gyroscope, and the gyroscope measures the shape of the	7	So there are all sorts basically what it's saying
8	tube, and so by integrating the rotations, basically,	8	is the soil is a lot stiffer than was expected. And
9	you get deflection.	9	I've already said to you that there's a large reserve
10	And so through the life of the construction, if you	10	capacity in the bottom of the slab, really, based on,
11	drop the gyroscope down at weekly intervals, you get	11	really, purely structural considerations. But having
12	a record of how the wall is moving. Some of the other	12	said that, we would make sure there was enough steel in
13	holes are for acoustics and other holes are for grouting	13	there for robustness. There we are.
14	the base.	14	Could I have the next slide, please. I just wanted
15	And so we've taken a number of those inclinometer	15	to really touch on what that 50 per cent meant. I think
16	readings and they are all remarkably consistent that	16	I've described to you this curve just now, but if you
17	there's hardly any movement in the wall. When I looked	17	look at the "460 characteristic strength", that's what
18	at them I thought have they been out there measuring	18	the discussion has been about, what is the bar that's
19	them, but we've looked at about please don't hold me	19	been used on the construction, and it's interesting on
20	to this, but well in excess of a dozen, and they are all	20	this curve, this must have been a 500 bar, because you
21	showing very low movements, and in fact, in some cases,	21	can see it goes above the 460.
22	you reckon, on the depth of the walls we've got,	22	But we only design to 400, so although if a bar is
23	a tolerance of probably in excess of 5 millimetres, plus	23	460, we reduce that by using material factors to 400.
24	or minus, thereabouts, and we are recording movements of	24	So when we talk about ultimate limit state, we are
25	about 15, I think, that sort of number.	25	designing at 400MPa. But because of our load factors
	Page 110		Page 112
1	So what does that mean? It's good news. It's	1	the maximum the structure would be working at is the
2		•	the maximum the structure would be working at is the
1	lovely. It really means, if you're not getting	2	260. That's the working stress. That's if you've got
3	movement, you are not getting bending moments. If		260. That's the working stress. That's if you've got the full load and the minimum amount of steel required.
	movement, you are not getting bending moments. If you're not getting bending moments, you're not	2	260. That's the working stress. That's if you've got
3	movement, you are not getting bending moments. If	2 3	260. That's the working stress. That's if you've got the full load and the minimum amount of steel required.COMMISSIONER HANSFORD: This is irrespective of the grade of steel used?
3 4	movement, you are not getting bending moments. If you're not getting bending moments, you're not	2 3 4	260. That's the working stress. That's if you've got the full load and the minimum amount of steel required.COMMISSIONER HANSFORD: This is irrespective of the grade of steel used?A. No, it would be proportional. So if it was 500, then it
3 4 5	movement, you are not getting bending moments. If you're not getting bending moments, you're not graunching things, you're not applying load. So the utilisations that I mentioned to you earlier are all to do with calculated analyses. They are	2 3 4 5	260. That's the working stress. That's if you've got the full load and the minimum amount of steel required.COMMISSIONER HANSFORD: This is irrespective of the grade of steel used?A. No, it would be proportional. So if it was 500, then it would be a ratio of 10 per cent higher, probably 300.
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1	Page 113		Page 115
1	predicted deflection, and I call it the "Arup modified	1	connections. There's a slight variation in tension, as
2	model" because we took the Atkins model and we made	2	Mr Southward pointed out. When a train, in a normal
3	a few little adjustments for ourselves, you know,	3	situation, would go by there's a slight increase in
4	carrying out checks.	4	stress, but it's just a little bit. It's not cyclic in
5	So we were predicting let's call it 45, I don't	5	the sense you're going backwards and forwards.
6	want to be alarmist at 50, but the green and blue lines	6	And the point that I've got to emphasise again and
7	are us trying to work out what the actual stiffness of	7	I don't want to bring up the earlier slide I showed
8	the soil is based on the inclinometers. You can see	8	you the trains on the EWL slab effectively sit on the
9	there's quite a dramatic difference, in fact more than	9	D-wall, because the slab extends across it
10	I would have thought. We are about a third. Normally	10	COMMISSIONER HANSFORD: In some cases slightly off.
11	in Hong Kong, other experiences are that it's about	11	A. Yes, it is. On one side you've got one wheel firmly on
12	40 per cent, but this is a bit it's in the bounds of	12	it and the other one slightly off, and on the other side
13	expectation but it's lower than even I would have	13	it's right parallel to it. So it's not going to give
14	thought.	14	you large vibration. It's going to give you because
15	Moving on, please, to the next slide.	15	to get vibration, you've got to excite something, and to
16	Basically, the discussion, while I've been here	16	excite something you've got to be in a position where
17	anyway, has always been about the coupler connections,	17	you can bounce it.
18	and they are really they are in the top and the	18	So I've got no concerns about cyclic loading. In
19	bottom of the construction, as we all know.	19	fact, it would be criminal to consider things like
20	As far as the EWL slab is concerned, there's only	20	cyclic testings on things like that. I mean, you can go
21	a few areas of couplers in the top. I say "a few	21	all sorts of things
22	areas", there are ten individual panels or parts of	22	COMMISSIONER HANSFORD: Criminal?
23	panels. And why are they there? They are there because		A. It's criminal because it would mean that you would be
24	of the sequence of construction. There was a whole	24	rejecting an opportunity to use something. You are
25	series of underpinning works that had to be done early.	25	being malicious in your rejection of something which
	Page 114		Page 116
1	So when the contractor started his alternative design,	1	would otherwise be sound.
2	those temporary works were already in place and he	2	COMMISSIONER HANSFORD: Interesting.
3	couldn't replace them.		-
		3	A. I mean did I explain it well enough?
4	So generally the top of the EWL slab is the	3	-
4 5	contractor's alternative design, and I make no apology		A. I mean did I explain it well enough?COMMISSIONER HANSFORD: I understand. Yes.A. Could I have the next slide, please. This is to just to
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5	contractor's alternative design, and I make no apology for saying that in my opinion it is a superior detail. I'm not going to say anything more about construction	4 5	 A. I mean did I explain it well enough? COMMISSIONER HANSFORD: I understand. Yes. A. Could I have the next slide, please. This is to just to emphasise, really and I still don't understand why we've got the same amount of reinforcement in the bottom
5 6	contractor's alternative design, and I make no apology for saying that in my opinion it is a superior detail. I'm not going to say anything more about construction joint. I think everybody has trampled over that enough	4 5 6	 A. I mean did I explain it well enough? COMMISSIONER HANSFORD: I understand. Yes. A. Could I have the next slide, please. This is to just to emphasise, really and I still don't understand why
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	Page 117		Page 119
1	Does that make sense, sir?	1	COMMISSIONER HANSFORD: I fear you might.
2	COMMISSIONER HANSFORD: I think we might want to revisit	2	A. Okay. I'm sure I might but I'm used to that. 50 years
3	that point slightly.	3	makes you a bit impervious to some of these things.
4	A. I didn't mean to bring it in.	4	Could I have the next slide, please. Now, the
5	COMMISSIONER HANSFORD: No, no, no, I don't want to	5	strength characteristics I did say to you earlier
6	interrupt your presentation, but there is a flip-chart	6	about some of the earlier research I did in my life, so
7	here, and maybe at a later stage, if appropriate, we	7	I wasn't surprised with 60 per cent. In fact, I think
8	will see how that A shape might fit with this.	8	if you were pushing it you would go to 50. That's why
9	A. Okay. Look, believe me, I fully support Mr Southward in	9	I'm happy with 60, because I think it gives you
10	terms I like As. As long as the surface is	10	a prudent reserve.
11	prepared I mean, people think it's got to be like	11	But I'll come on to that later. It requires this
12	that (demonstrating), but what about the construction	12	next stage in my three stages of arriving at the full
13	joint that there was going to be against the diaphragm	13	stop, which is proper testing. And indeed they are
14	wall? That's vertical. You know, is that bad news?	14	MTR are embarking upon the testing programme that
15	No, it's all to do with the preparation of the surface	15	I would expect, which would be nine specimens of each
16	which is very, very important.	16	engagement, and statistically that is what you would use
17	COMMISSIONER HANSFORD: That's fine.	17	in a production engineering situation. If you are
18	A. And the other point that's come out in the discussion is	18	looking for whether a batch is strong enough, you would
19	the doweling action that you get, you know, it controls	19	tend to take nine samples from something in excess of
20	all sorts of things.	20	I think the overall I used to use was anything in
21	Anyway, next slide, please. And I think this one	21	excess of 500 as a batch, you would take nine and you
22	probably does show what I was just saying quite well,	22	would test them, to demonstrate that the batch was good,
23	actually. If you see the blue area, it almost does	23	and that would hold for even larger numbers, 1,000,
24	coincide with the shear key. But again I emphasise I'm	24	2,000 or whatever.
25	very happy with that detail.	25	COMMISSIONER HANSFORD: You have been appointed by MTR, bu
	Page 118		Page 120
1	Next slide. Now the coupler characteristics.	1	of course you are independent.
2	I mean, there's a lot of talk that goes on about ductile	2	A. Yes.
3	couplers. Well, type I couplers are ductile. The	3	COMMISSIONER HANSFORD: But I don't think we've heard about
4	stress/strain curve I've just shown you twice, I do	4	these additional tests from MTR. Do you know when?
5	apologise for that that is the stress/strain curve	5	Have you been told when these are happening?
6	for a type I coupler. So type I couplers and type II	6	
7			A. I think they are very imminent and I think these have
	couplers are ductile.	7	been discussed with BD. I don't think they've just gone
8	The difference is that a type II coupler can take	7 8	been discussed with BD. I don't think they've just gone out on a limb.
8 9	The difference is that a type II coupler can take the seismic loading, can take the stress reversals, and	7 8 9	been discussed with BD. I don't think they've just gone out on a limb. COMMISSIONER HANSFORD: Perhaps Mr Boulding will tell us
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	Page 121		Page 123
1	The slab is designed as a suspended slab, so	1	report that we did, the bending moment down here becomes
2	therefore it's a suspended slab as far as the world is	2	more critical than the bending moment up there.
3	concerned. That's like me saying black is white,	3	So it was a near-run thing, mathematically, but
4	because physics has a way and natural life has some	4	fortunately the wall never moved anyway. But it's
5	other ways of telling you that it doesn't matter how	5	a warning, really, of where following rules is daft.
6	you've designed it, it's how it will work, and if you	6	You've always got to ask whether the rule is
7	cast a slab on the ground which has been surcharged for	7	appropriate. That's all. That's all I ever ask. You
8	over 50 years by soil which is 15 metres deep, which is	8	know, rather than, "You do it that way or you don't do
9	probably approaching 3 tonnes a square foot, you are	9	it at all" I mean, that doesn't make any sense.
10	going to assume that that's going to settle under the	10	COMMISSIONER HANSFORD: Are you saying following rules
11	slab? There's more likelihood it will swell.	11	blindly is daft?
12	So designing it as a suspended slab is effectively	12	A. No, I say "following questions unquestioningly". No,
13	putting an air gap under it. Now, you say, okay, that's	13	the blind is not unquestioning is a much better way
14	conservative, and the water is going to come along and	14	of doing it, because I'm sure everybody wants
15	lift it up and that's all right. But the problem is	15	COMMISSIONER HANSFORD: No, I was just trying to understand
16	that slab is connected into the diaphragm walls on	16	You weren't saying following rules is daft?
17	either side, so the mathematical design assumes the slab	17	A. No. I think rules are important in any society. But
18	deflects or pulls the wall over in a hogging fashion,	18	you've got to understand whether the rule is
19	and then when you put the water on, it pushes it up, but	19	appropriate, and you can only do that by asking
20	the datum point for the pushing up is in this sag	20	questions, and if the other side turns around to you and
21	position. I can do a sketch to explain. But what it	21	says, "That's the rule", then we've got a real problem,
22	is: it's unsafe.	22	haven't we, as a society? A society that doesn't
23	COMMISSIONER HANSFORD: A sketch would be helpful.	23	understand the fact that you don't always get it right
24	A. I'm not very good at drawing.	24	because it's written down. It doesn't always apply.
25	COMMISSIONER HANSFORD: The next page.	25	COMMISSIONER HANSFORD: We'll leave it there.
	Page 122		Page 124
1	Page 122 A. I don't want to spoil that.	1	Page 124 A. That's all. I can only speak as I find, really.
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	Page 125		Page 127
1	operatives they know that if they do the job right	1	how does ten help you?
2	first time, it's the easiest thing in the world.	2	So the continuing process, you've learnt what you've
3	Bodging costs time and runs the risk of you being	3	learnt. The reason why the other reason why I want
4	identified as an individual and having to do it again.	4	to possibly hopefully make a plea for stopping the
5	COMMISSIONER HANSFORD: But it helps if they can see the	5	opening-up is because then we can get back to building
6	flag on the hill.	6	the thing and finishing it and getting it operational.
7	A. Absolutely. Toolbox talks, in the morning: "What did we	7	That's where I'm coming from. It isn't, "You are
8	do yesterday? What are we going to do today? Could we	8	weakening the structure further."
9	do it better?" That's the spirit. That's what you've	9	COMMISSIONER HANSFORD: I understand.
10	got to do.	10	A. Just think of how much value that is to society for
11	Anyway, I don't want those issues to cloud this one	11	every week that goes by. Why do it? There's no reason
12	of safety. The construction, really, of that station	12	Anyway, the last point is the stage 3 holistic
13	should be allowed to continue, because when you think	13	proposal re-analysis that we are doing. We've actually
14	about it, every day you are denying society an asset	14	started now.
15	that it can use. Why? There's physically no reason	15	COMMISSIONER HANSFORD: Sorry, who?
16	from a technical point of view why you can't do that.	16	A. Sorry, I should explain. The holistic proposal had
17	I would go and I say why I mean, technically	17	a stage 3 to it, which was the re-analysis of the
18	the structure has a very large reserve of strength.	18	structure
19	I look forward to seeing the calculations for the	19	COMMISSIONER HANSFORD: Yes.
20	construction joint, and if necessary I will join in the	20	A using the as-built information and the best
21	debate I've stayed out of it at the moment because	21	information we have available. Indeed we and Atkins
22	I think there are people who have enough knowledge to	22	and we've started that process now of compiling our
23	deal with that. But, as Mr Southward pointed out,	23	basis of design and making sure we've got the right
24	there's no evidence to show any distress whatsoever.	24	records to be able to do it. So we've started on that.
25	Anyway, to my very last slide you will be glad to	25	MR BOULDING: Good.
	Page 126		Page 128
1	hear that "Way forward". I seriously think we should	1	A. Is that that is it.
2	review the scope of the opening-up. It doesn't involve	2	Q. Thank you, Dr Glover. I just have a few questions by
3	me as an individual but I think we have something like	3	way of clarification. This proposed stage 3 of the
4	80 areas opened up. I think that is more than enough.	4	holistic proposal, I want to be clear about the
5	My earlier reports show that that's more than enough to	5	intention. Will that include direct force and
6	establish a trend statistically, whether it's 37 you are	6	elongation tests on the coupler assembly?
7	interested in, 32, 26, there's enough there.	7	A. Yes. I mean, the tests thank you very much for
8	Opening up more will not change that picture, to the	8	that the test we intend to or MTR intend to carry
9	extent that it is statistically important. You can't	9	out, as I say, is nine samples, covering direct tension
10	stop it today, and maybe you don't have the authority to	10	and compression, and the elongation I would like you
11	stop it, but what I'm saying is I think it's increasing	11	to know that the elongation is the width of your hair,
12	the nihilism of the whole process, really, to continue	12	0.1 millimetre.
13	it, but that's for other people.	13	COMMISSIONER HANSFORD: Yes.
14	COMMISSIONER HANSFORD: And is it damaging?	14	A. That's the level of concern we're having.
15	A. Well, with that reserve of strength, I've got to say no,	15	COMMISSIONER HANSFORD: Not the width of mine.
16	but you've got to repair things and the idea of even	16	A. Interestingly enough, if you were in Texas, for example
17	digging out the second layer or the third layer or the	17	you wouldn't have 0.1, you would have 0.25, and I think
18	fourth layer you won't get any better data than	18	California is another number.
19	you've got now, and the data is it shows you a range	19	What I'm saying is the 0.1 is a measurement of the
20	of responses. What do you expect by opening up more?	20	product passing. It's not a structural integrity issue.
		21	It's an indicator of what that thing does, because when
	Is it the "I told you so"? I mean, it's not going to	<u></u> 1	
21	Is it the "I told you so"? I mean, it's not going to happen. And the police have enough information now,		-
21 22	happen. And the police have enough information now,	22	you imagine it, this test is done in the open air, but
21			-

there isn't. Opening up -- if you found one or two or
whatever number of, let's say, wrongdoings, for example,
25

32 (Pages 125 to 128)

So this thing about elongation -- yes, elongation

	Page 129		Page 131
1	will be included, but not cyclic. That would come under	1	that you are looking on the right-hand side I think is
2	the heading of malicious.	2	the shear key. It seems to match, doesn't it?
3	MR BOULDING: I've got one other matter, and the people who	3	MR PENNICOTT: I see it.
4	put things up on the monitor are very clever I wonder	4	A. And the concrete on the left-hand side is the prepared
5	if we could have slide 19 up at the same time as we have	5	concrete, and you can actually see the shape of that.
6	photograph B19/25587, because do you remember you were	6	So that's what I was saying.
7	asked about the photograph that I think Mr Chow was	7	MR BOULDING: That's what you were saying. Okay.
8	discussing with one of the witnesses earlier?	8	Now, Dr Glover, the process will be that various of
9	Then if we could have your slide 19 up alongside	9	the lawyers in the room have declared an intention to
10	that.	10	ask you questions, and it starts with my learned friend
11	A. Yes. In fact, could you show the cross is slide 19	11	Mr Pennicott in the front row, and after that
12	the cross-section?	12	questioning it might be that I ask you a few further
13	Q. The cross-section?	13	questions, and of course the Chairman and the professor
14	A. Yes, the one that shows the couplers, the green one.	14	can ask you questions whenever it takes their fancy.
15	That one will do, yes.	15	WITNESS: Okay.
16	Q. Now, can you explain	16	CHAIRMAN: Good. I think it's 20 to 4. 15 minutes.
17	A. What we are looking at?	17	Dr Glover, you have heard other people being warned
18	Q what we are looking at?	18	that when they are giving evidence, they remain
19	A. The photograph is taken this is a supposition on my	19	an island unto themselves.
20	part, but looking at the two side by side, I think it	20	WITNESS: Okay.
21	explains it quite well.	21	CHAIRMAN: You are not permitted to discuss your evidence at
22	The photograph is taken standing slightly outside	22	this stage.
23	the line of the diaphragm wall. The right-hand side of	23	WITNESS: Okay. Thank you.
24	the photograph is inside the diaphragm wall sorry, is	24	(3.37 pm)
25	inside the excavation.	25	(A short adjournment)
	Page 130		Page 132
1	Page 130 So when you look at the blue bars	1	Page 132 (3.56 pm)
1 2	-		
	So when you look at the blue bars		(3.56 pm)
2	So when you look at the blue bars COMMISSIONER HANSFORD: Sorry, is this therefore the reverse	2	(3.56 pm) MR BOULDING: Dr Glover, just before Mr Pennicott starts,
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	Page 133		Page 135
1	However, could I just take up a couple of points	1	it?
2	with you. First of all, right at the end of your	2	COMMISSIONER HANSFORD: Are you saying any movement has
3	presentation, the very last slide, you had the "Way	3	already happened?
4	forward".	4	A. Not any movement. You could get a crowd of people
5	A. Mm-hmm.	5	sitting on the thing, but at the moment you've got
6	Q. You will have seen, I think, in Prof McQuillan's report	6	something like 90 units. If you put all the people on
7	that one of the recommendations that he makes and is in	7	the platforms and brought the trains in, you've got
8	favour of, going forward, is a system of fairly	8	another six. So that's the proportion. So you've got
9	sophisticated monitoring at the station. Is that	9	something less than 10 per cent of the full loading to
10	something that you would go along with?	10	go and probably less. With that as backcloth, a 3 metre
11	A. I would go along with it, because I think that's what is	11	slab has a lot of inertia.
12	expected. As a personal approach towards such things,	12	All I'm saying is by all means do that because
13	I never embark upon monitoring anything unless	13	people will expect it, but please don't expect anything
14	I understand what I'm going to get is going to be	14	from it, and expect people to query why you're not
15	meaningful, because there's no point. So I understand	15	getting anything from it. That's all. Does that help?
16	there's two perspectives to this. One is: is it needed?	16	MR PENNICOTT: That's helpful, and you'll be pleased to hear
17	And from a technical point of view, not. From a public	17	that broadly accords with what Prof McQuillan thinks as
18	perception, then I think the answer to that must be	18	well.
19	a resounding yes.	19	A. That's always a good thing.
20	Q. Right.	20	Q. Can I just follow up by asking you this. You pointed
21	A. But I think it's important that all parties involved,	21	out again in the "Way forward" slide that Ove Arup and
22	including the public, understand that it's very likely	22	Atkins, I think, are carrying out stage 3 of the
23	that what they'll get is noise, because it won't move,	23	holistic study which I think is some sort of
24	and the trains, as I've explained, run on the diaphragm	24	retrospective analysis of the structure.
25	wall. So I'm not sure what you would be measuring, and	25	A. Yes.
	Page 134		Page 136
1	to be honest the degree of movements that you will be	1	Q. Will that study, that stage 3 element, in any way inform
2	getting, the particular equipment that you would need to	2	what future monitoring or similar needs to be done, or
3	use has to be thought about very carefully, because it's	3	are the two things completely unconnected?
4	not like having a sight line and a classic measuring	4	A. I think the two things are separate. I'm just pondering
5	device. The movements are that small and you always run	5	whether I think that analysis would give you, in fact
6	a risk when you start a programme such as this that	6	will give you, an indication of what those fluctuations
7	people will say the system is wrong, something must be	7	might be, and I think that could inform the mechanism or
8	moving. So I would suggest that if you do do that, and	8	the means by which you the sort of instrumentation
9	I think I can understand the reasons for it, you've got	9	that you could install.
10	to be very frank with the public at large not to expect	10	It certainly could give you an indication of that.
11	to get daily or weekly or monthly readings which show	11	The models will be good enough to give you
12	anything at all.	12	an understanding of what the likely deflections could be
13	COMMISSIONER HANSFORD: So it's an assurance?	13	in the future.
14	A. It's an assurance.	14	Q. Right. That's helpful. Thank you very much.
15	COMMISSIONER HANSFORD: You said all you are going to get in	15	Could I then ask you to be shown possibly easiest
16	noise. In this context, what do you mean by "noise"?	16	on the screen a page in the opening-up file, that's
17	A. Noise in the readings. Everything has got a plus and	17	OU, and could we go to 338, please. And could we blow
18	minus about it. You get a fluctuation naturally. So,	18	that up.
19	therefore I could be proved wrong, life is like that,	19	I imagine this is something you've been looking
20	but my appreciation of the issue before us you've got	20	at
21	something of the order of in excess of 90 per cent of	21	A. Yes, it is.
22	the weight, so	22	Q like the rest of us on an almost daily basis,
23	MR PENNICOTT: It's already there.	23	Dr Glover.
24	A. It's already there. So what's going to disturb it to	24	In terms of safety, which of these results, to your
25	the extent that you will get anything meaningful out of	25	way of thinking, are of relevance and importance?

34 (Pages 133 to 136)

	Page 137		Page 139
1	A. Well, they are all relevant, because they add to	1	evidence, the bottom bar or bottom rebar or bottom mat
2	a statistical story, so every single one of them is	2	is always in compression.
3	important.	3	A. Yes.
4	But there are two rogue values, and what I mean	4	Q. And indeed, taking an extreme position, forgetting about
5	"rogue" could be taken in statistical terms incorrectly,	5	compliance with the codes, none of that rebar is
6	meaning they are incorrect and tampered with but no,	6	actually necessary.
7	the 6.22, and there's one further on, 9.4 at 22, and	7	A. Well, I would like to say some of it would be nice to
8	6.22 at 5 they did surprise me slightly, but the rest	8	have around, but no. You are probably looking at
9	are pretty tight, in terms of I know we argue about	9	something less than a third.
10	millimetres, and we see them the problem with	10	Q. So when I say in terms of safety, on one view it might
11	millimetres is they end up with a large number when you	11	be thought, well, it doesn't really matter what's there,
12	record them. I mean, 40 sounds a big number, you know,	12	in terms of absolute safety?
13	and the difference between 40 and 38 seems to be huge,	13	A. Yes, absolutely.
14	but actually these are minute measurements, and I do	14	Q. That's something you would agree with?
15	know how these are put together, because you use the	15	A. I would agree. The phrase "so what" comes to mind.
16	electronics to measure the engagement, but the bit	16	Q. Okay. In your report, if we could just go to that,
17	outside is measured by a tape, and tapes are notoriously	17	please, with the tests in the back of our minds, could
18	inaccurate. In fact it's a straight tape.	18	I ask you, please, to go to paragraph 8.2 of your
19	Because it is a crime scene, the operatives haven't	19	report. That's at page 10, ER, tab 6.
20	been able to get back and because I want them to	20	A. Yes.
21	check that particular measurement using a steel gauge or	21	Q. You say there:
22	something so although I'm very happy with the	22	"The allegations of cutting of threaded bars had to
23	measurement that's been taken by the ultrasonics,	23	be investigated to allay concerns about the extent of
24	I would put a bit of a health warning on some of the	24	such malpractice, but that should not obscure the fact
25	tape measurements because what you are seeing there is	25	that such malpractice would have to have been on such
	Page 138		Decc. 140
	1 450 150		Page 140
1	a combination of two things.	1	an unimaginable industrial scale and, in addition,
1 2	-	1 2	-
	a combination of two things.		an unimaginable industrial scale and, in addition,
2	a combination of two things. I'm not saying the results would be vastly	2	an unimaginable industrial scale and, in addition, focused in specific areas, to have any effect whatsoever
2 3	a combination of two things. I'm not saying the results would be vastly different, but it would just give that little bit of	2 3	an unimaginable industrial scale and, in addition, focused in specific areas, to have any effect whatsoever on the structural integrity of this construction,
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	Page 141		Page 143
1	doesn't make sense, to cut the bar and then put it	1	them, or are they to be argued or are they to be
2	there comes a time when it's not plausible.	2	followed by Prof Yeung wishing to then give oral
3	But I think the answer to your question is: is there	3	evidence to
4	a sufficient statistical base now? I would think most	4	MR TO: No, I think he just wants to make a statement
5	certainly.	5	relating to what was stated in the PowerPoint.
6	CHAIRMAN: I think your words were "I would think most	6	(Commissioners conferring)
7	certainly"; is that right?	7	CHAIRMAN: I think this is what concerns us please, I'm
8	A. Yes.	8	not trying to be pedantic or difficult, but then the
9	CHAIRMAN: I'm sorry, it's just that the transcriber who	9	comments come in in writing, and then is Dr Glover given
10	does a fantastic job day by day has put "almost	10	an opportunity he may have finished his evidence this
11	certainly". Let me emphasise yet again I have worked	11	afternoon maybe; we don't know and then how does he
12	with this transcriber before and she has proved her	12	answer? Does he answer in writing? Because if they are
13	again and again to be superb, but it's just occasionally	13	comments made, normally what would happen is that if,
14	something pops up.	14	for example, Prof Yeung was here and he could give you
15	MR PENNICOTT: I see she's writing that!	15	verbal instructions, you would put the questions, there
16	Dr Glover, I did have a other questions for you but	16	would be an answer, and then Mr Boulding at the very
17	you've covered them already, particularly on the	17	end, if he felt that some point needed to be clarified,
18	elongation test and static load test which I was going	18	could deal with it. So we have a well-tried system.
19	to ask you about, but you have dealt with that, and	19	But we are stepping into difficult territory.
20	Mr Boulding took you to the photograph I was going to	20	MR PENNICOTT: Sir, if I may add just the observation you
21	take you to arising out of earlier evidence.	21	made earlier, which is the PowerPoints don't go outside
22	So thank you very much; I have no further questions.	22	the report, and I'm pretty confident the PowerPoints do
23	MR SHIEH: There's no questions from Leighton.	23	not go outside the report and I've looked at that
24	CHAIRMAN: Atkins? Sorry.	24	carefully. If Mr To was able to say to you, "Look, go
25	MR TO: Chairman and Commissioner, I just have a few	25	to a particular PowerPoint", and say, "Compare that
	Page 142		Page 144
1	Page 142 questions.	1	Page 144 PowerPoint with the report, there's a brand-new point in
1 2		1 2	-
	questions.		PowerPoint with the report, there's a brand-new point in the PowerPoint that's not in the report and we haven't had a proper opportunity of considering with
2	questions. The first question is our Prof Albert Yeung would	2	PowerPoint with the report, there's a brand-new point in the PowerPoint that's not in the report and we haven't had a proper opportunity of considering with Prof Yeung", then one could see that there might be the
2 3	questions. The first question is our Prof Albert Yeung would like to comment on Dr Glover's PowerPoint and he wants	2 3 4	PowerPoint with the report, there's a brand-new point in the PowerPoint that's not in the report and we haven't had a proper opportunity of considering with Prof Yeung", then one could see that there might be the basis of an argument for coming back on a new point.
2 3 4	 questions. The first question is our Prof Albert Yeung would like to comment on Dr Glover's PowerPoint and he wants to submit some documents tomorrow before 10 o'clock. CHAIRMAN: To make certain written comments, you mean? MR TO: Yes, written comments. 	2 3 4	PowerPoint with the report, there's a brand-new point in the PowerPoint that's not in the report and we haven't had a proper opportunity of considering with Prof Yeung", then one could see that there might be the basis of an argument for coming back on a new point. But I'm bound to say I don't see any new points of
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	Page 145		Page 147
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1	basis of those instructions he ought to cross-examine	1	stimulating. Originally, I prepared four pages of
2	Dr Glover on the matter. Then, as you have observed,	2	questions for you, but having heard your presentation
3	I would then pick up anything that was not clear by way	3	a lot of them actually are gone.
4	of re-examination.	4	First of all, I also appreciate that you took the
5	I'm very concerned if we are going to get some sort	5	trouble to address the government's concern in relation
6	of written response which no doubt I would then have to	6	to COWI's calculation. We do appreciate that this
7	consider with my expert when he comes out of the box and	7	morning, maybe, when I explored with Mr Southward
8	it might even be that I have to say, "Prof Yeung has to	8	regarding that particular load case number 5, which
9	be recalled because on the basis of what I've been	9	according to COWI's analysis result shows significant
10	instructed I now need to cross-examine him again", and	10	sagging moment along the east side of the diaphragm
11	this merry-go-round frankly has to stop, there must be	11	wall.
12	fair play, and Mr To must have fair play and it may well	12	A. Understood.
13	be that, with others in the room who want to	13	Q. We also appreciate that the combined loading together
14	cross-examine, Mr To could delay his cross-examination	14	with the superimposed the rest of the loading, the
15	until tomorrow morning and take instructions overnight.	15	final the resultant moment is hogging.
16	CHAIRMAN: I think that's essentially the best answer.	16	A. Yes.
17	Mr To, I don't want to change the process. It's	17	Q. The reason why we still ask the question and we still
18	a process that's well tried in our English and Hong Kong	18	explored it with Mr Southward is because we want to make
19	common law system. But I don't, on the other hand, wish	19	sure that there is no problem with the modelling, and we
20	to deprive of you putting questions.	20	need to understand why, for a particular load case, we
21	Now, it seems to me we are at 20 minutes past 4. We	21	have this result, having a sagging moment all along.
22	can complete any necessary questions from other counsel	22	A. Yes.
23	if they wish. You will then have an opportunity to take	23	Q. Our concern is the gradient of the change of the moment
24	instructions overnight from Prof Yeung, and if the	24	over a very short distance, less than 600 millimetres,
25	professor wishes any particular matters to be put	25	because we know that the overall thickness of the
	Page 146		Page 148
1	forward and you deem it appropriate to do so, as	1	diaphragm wall is 1.2, according to COWI the moment at
2	an officer of this Commission because we are all	2	the middle of the diaphragm wall is a hogging moment.
2			the modele of the diaphragin wan is a nogging moment.
3	officers of the Commission then you can do so	$\begin{vmatrix} 2\\ 3 \end{vmatrix}$	A. Yes.
4	officers of the Commission then you can do so tomorrow morning. That will give you an opportunity		A. Yes.
	-	3	
4	tomorrow morning. That will give you an opportunity	3 4	A. Yes.Q. On the surface of the diaphragm wall, which is at the
4 5	tomorrow morning. That will give you an opportunity overnight and you can put the questions and nobody is	3 4 5	A. Yes.Q. On the surface of the diaphragm wall, which is at the maximum 600 millimetres away from the centre, it has
4 5 6	tomorrow morning. That will give you an opportunity overnight and you can put the questions and nobody is prejudiced.	3 4 5 6	A. Yes.Q. On the surface of the diaphragm wall, which is at the maximum 600 millimetres away from the centre, it has changed to a sagging moment, and to us the gradient of
4 5 6 7	tomorrow morning. That will give you an opportunity overnight and you can put the questions and nobody is prejudiced. MR TO: Mr Chairman, I agree with you, and also the	3 4 5 6 7	A. Yes.Q. On the surface of the diaphragm wall, which is at the maximum 600 millimetres away from the centre, it has changed to a sagging moment, and to us the gradient of the change is very substantial, and that poses
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37 (Pages 145 to 148)

	Page 149		Page 151
1	station box, it's a composite of different models.	1	COWI's analysis, perm 5 has to be a combination of both
2	There's not one model. We have to get different effects	2	loading that you have drawn; right? Because according
3	from different models. And the bending moment, the	3	to COWI, at the centre of the diaphragm wall, the moment
4	hogging at the supports, comes from the Plaxis analyses,	4	there, the hogging moment
5	the ones that model the soil and the wall.	5	A. There's always a problem at the boundary conditions, and
6	So a Plaxis model would look like this (drawing with	6	that's what we lop we call lopping it, like chopping
7	red marker). That's the NSL slab and there's the EWL	7	a tree because this support here (indicating), if you
8	slab. But to get to that stage and there's the	8	look at it, if you magnify it, that is a plan you are
9	soil we do a stage-by-stage construction. So the	9	looking at the top of the diaphragm wall, and this is
10	first stage and Prof McQuillan will show this,	10	the centre line, so although this is a wall, we model it
11	I think; he's got a number of slides so that slab is	11	as part of the slab, generally. So you end up with this
12	cast on the ground, and then we excavate it, and this	12	area because you want to make sure you've got
13	model is modelling each one of those stages.	13	equilibrium so you've got to take them to the centre.
14	So the Plaxis model gives us the bending moment that		But this bending moment here, so if you superimpose the
15	we apply at that point (drawing an arrow), but it	15	bending moment down here, it's doing something like
16	doesn't model the slab. All that it gives us is the	16	that, I should imagine (drawing with blue marker), and
17	input at the end.	17	that's why you are getting this little bit of hogging,
18	So what we do to model the slab is we do that	18	but actually, if you lop it, you are all right.
19	(drawing a second diagram), and that's what we call	19	I'm afraid in any modelling in life, there's always
20	simply supported. I think you know that; yes, of course	20	a little bit of correction, but we understand that, and
21	you do.	21	equilibrium is maintained. So that's why you get
22	Q. So apply the bending moment, that's Plaxis?	22	please, I haven't looked at the analysis in detail, but
23	A. That's right. So what you do there's one load case,	23	I can understand what you are describing.
24	which I guess in this case is PERM 5, you've referred to	24	Q. Neither do I. I guess that's as far as I can go on
25	it, and that ends up the bending that looks like that	25	A. I'm sorry, that's about as far as I can go.
	Page 150		Page 152
1	Page 150 (drawing on the whiteboard), but then the other load,	1	Page 152 Q. The next area I would like to discuss with you is
1 2	-	1 2	-
	(drawing on the whiteboard), but then the other load,		Q. The next area I would like to discuss with you is
2	(drawing on the whiteboard), but then the other load, which is coming from Plaxis, has another bending moment,	2	Q. The next area I would like to discuss with you is just now I heard you explaining to us, as a layperson,
2 3	(drawing on the whiteboard), but then the other load, which is coming from Plaxis, has another bending moment, and it looks probably like that. You notice this is on	2 3	Q. The next area I would like to discuss with you is just now I heard you explaining to us, as a layperson, about the water pressure. You mentioned about 15 metres
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	Page 153		Page 155
1	Q is always in tension, because	1	that something I've got to draw?
2	A. Only at the supports.	2	COMMISSIONER HANSFORD: No, no, no.
3	Q. At the support, yes.	3	A. So therefore the NSL slab, although it's being subjected
4	A. Yes.	4	to this water pressure, it's being supported by the
5	Q. And it's also at the support that we have these coupler	5	diaphragm walls on either side, the upthrust in the
6	connections.	6	middle of the spans is being taken up to the EWL slab,
7	A. Correct.	7	so they are sharing the load together, so you are
8	Q. At the moment, the experts I think my impression is	8	mobilising the 5 metres, and in addition to that there
9	there's not much coverage talking about the couplers,	9	are secondary we call them barrettes in the middle of
10	the criticality of the couplers at the bottom steel	10	the span, and that's also anchoring it.
11	at the interface between NSL and the diaphragm wall.	11	So when you add all those effects up, the actual
12	A. Yes.	12	let's call it the bending moment rather than getting
13	Q. If what I have just described is correct, then the	13	into sagging and hogging you know, the upward bending
14	effectiveness of the connection by the couplers between	14	moment at the support is quite modest, the utilisation
15	the bottom steel of NSL slab and the diaphragm wall is	15	levels there, and we've got to do the analysis to
16	an important matter that we need to look at.	16	demonstrate this but they are not going to be high. So
17	Now, I believe that it is indisputable that they are	17	that's the first thing.
18	not accessible for us to look at the workmanship.	18	I did take account of that in my statement, that
19	A. Mm-hmm.	19	I think the structure is safe, you know, with full
20	Q. I also believe that that is one of the reasons why we	20	recognition of the fact, the vulnerability of that.
21	have this opening-up exercise at various locations.	21	The second thing you've got to remember is
22	The government engaged experts in statistics and the	22	underneath the NSL slab, there's a very substantial
23	government was advised by those experts as to how the	23	waterproof membrane sitting underneath. So it's not as
24	opening-up work should be carried out, so as to get	24	if you know, water does leach through to some extent,
25	representative data to reflect the quality of the	25	but for those of you who understand metallurgy, you
	Page 154		Page 156
1	Page 154 couplers.	1	Page 156 think about rust, everybody gets concerned about rust,
1 2	-	1 2	
	couplers.		think about rust, everybody gets concerned about rust,
2	couplers. A. Mm-hmm.	2	think about rust, everybody gets concerned about rust, but the interesting thing about rust is it needs three
2 3	couplers. A. Mm-hmm. Q. If the quality of the couplers at the NSL slab is so	2 3	think about rust, everybody gets concerned about rust, but the interesting thing about rust is it needs three components to take place. It needs iron, it needs
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2 3 4 5	couplers.A. Mm-hmm.Q. If the quality of the couplers at the NSL slab is so important, which I believe that you agree with me, at least up to this point, and there is no way that we can	2 3 4 5	think about rust, everybody gets concerned about rust, but the interesting thing about rust is it needs three components to take place. It needs iron, it needs water, and it also needs oxygen. And so if you don't have all three of those, you don't get rust. That's the
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2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	 couplers. A. Mm-hmm. Q. If the quality of the couplers at the NSL slab is so important, which I believe that you agree with me, at least up to this point, and there is no way that we can open up any of the couplers at the bottom of the NSL slab, do you agree with me that to be able to have a more representative picture of the quality of the couplers in the NSL slab, we need to continue with our opening-up proposal or scheme or whatever? A. Is that your question? Q. Yes. A. So your question is Q. Yes. A. I will try not to make the answer long. The slab is not resisting all the water. The water is pushing on the slab, but the slab is doing in fact, it's getting support from three different locations. That's why I said the structure has two lives. In the first case, the EWL slab is spanning on its own, and as you say the 3 metre weight is only going through to the diaphragm walls. 	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	 think about rust, everybody gets concerned about rust, but the interesting thing about rust is it needs three components to take place. It needs iron, it needs water, and it also needs oxygen. And so if you don't have all three of those, you don't get rust. That's the first thing. So if you are in an environment where the level of oxygen is quite low, and I would think 15 metres down in the ground, without recharging of water, oxygen is quite low, so the risk of high corrosion from water is very low. The second thing is if you ever got a crack pattern, the crack pattern wouldn't run along the bars, it runs across the bars, and all the research shows that actually that is the least risk. So to answer your question, the utilisation levels of that structure are lower than you think because of the supports it has. It's got a waterproof membrane underneath it, and looking at the photographs, I didn't see it myself, but I can vouch from the photographs that it's there, and the risk of actual cracking and corrosion at the stress levels we are talking about is very, very low. That's my answer to you.

2 3 4	Q. And unless, having done that calculation, and we are satisfied that the bottom steel of the NSL slab is	1	going to get better. So if you do another 84, they are
2 3 4 5		2	
4 5		2	not going to change that percentage by very much. And
5	always in compression, as in EWL slab, the effectiveness	3	clearly you will, I guess, speak to a statistician and
	of the coupler	4	see whether what I'm saying is correct.
	A. No, sorry. I didn't say that the bottom of the slab	5	Q. Yes.
	would be in compression. It will be in tension, but it	6	A. There's always the possibility you are going to find
7	will be at a lower level than you suspect.	7	this black hole somewhere, but no, not with something
8	Q. Yes, I fully agree with what you mean.	8	like this.
	A. Sorry, I thought you said	9	Q. Just for your information, according to the latest
	Q. What I'm trying to say is unless having run those	10	opening-up result up to I believe yesterday, at the
11	numbers and coming to a result which shows that the	11	moment, if we apply the passing mark of 37mm
12	bottom steel is always in compression, otherwise the	12	I appreciate that MTRC is going to carry out extensive
13	effectiveness of the couplers is still an issue that we	13	tests and then perhaps at some point we need to review
14	need to ensure that at least it won't be too bad; is	14	this passing mark but at the moment, on the basis of
15	that right?	15	the information available to the government and to the
16	A. I'll answer two ways. First, you did say compression	16	public, we have recommendation from the supplier of the
17	again of the bottom couplers, and I'm saying to you they	17	couplers, and at the moment the passing mark is 37mm
18	will be in tension on the bottom. They will be in	18	engaged length.
19	tension, but the level of that tension is very low.	19	On the basis of this, at the moment the result is
20	Q. So long as it is in tension, do you agree that we need	20	that almost 49 per cent of the couplers exposed failed.
21	a proper connection	21	A. You mean in terms of the total sample?
22	A. Of course you do.	22	Q. Yes, that's right.
	Q to resist that tension?	23	A. In other words, 49 per cent of the planned number have
	A. Right. So we are agreed now that it's in tension at the	24	been exposed.
25	bottom.	25	Q. Yes. This is the situation that the government is
	Page 158		Page 160
	Q. Yes.	1	facing at the moment.
2	A. And I'm saying to you that the utilisation level is very	2	A. Yes.
3	low, because of the reasons that I've explained, which	3	Q. If at some later point in time we can adjust, if there
4	it's got multiple supports. So we agree that it's in	4	is justification to adjust the passing mark, then
5	tension and that I believe the utilisation is low.	5	of course people will review the situation, but on the
6	So then let's move to what is what do we expect	6	basis of what we have today, with 49 per cent failing
7	to get from the opening-up? I would say, with the	7	A. No, no, no, I'm sorry. I misunderstood your earlier
8	samples as they are now, probably about 84, you will not	8	statement. I thought you were saying that of the
9	find and you can speak to as many statisticians as	9	planned opening-up, you were 49 per cent. That's not
10	you like; I am not an expert in statistics but I use	10	what you meant; is that
11	them you will find the trend is already set from the	11	Q. 49 per cent
12 13	figures we have, and the fluctuation let's say, you know, arbitrarily, that something is coming out with	12 13	A. Or are you saying 49 per cent of the readings have failed?
13	a projection of 10 per cent at the moment. Then I think	13 14	Q. Yes, 49 per cent of the samples with the reading that
14	if you take another 84 or whatever it is samples, you	14	failed to pass the 37 millimetres passing mark. This is
15	will find that will fluctuate between probably	16	the situation at the moment.
17	8 per cent and probably 12. It won't affect what we	17	A. You see, we have a problem there, don't we, because
18	will do, because whatever we get from the results from	18	I don't recognise your number so we are going to be
19	the study, we will take a conservative view.	19	talking about statistics from two different points.
20	Let's say our utilisation levels are 60 per cent,	20	I see no reason whatsoever to accept the 37 and I'm not
21	then we will not necessarily use 60 per cent in our	21	giving that statement in the absence of any knowledge.
	analysis. We will use something much more conservative.	22	I fully expect a screwed fixing of any type to behave
22	-	23	such that you would get its full strength at something
	So my answer to you is you've got you, we, the	25	such that you would get its full strength at something
22	world has got sufficient statistics on the potential	23	much less than 100 per cent. So the idea you stick to

1	Page 161		Page 163
1	Q. May I just make a correction, I do apologise. I have	1	But I would still stand by the same statement that
2	just been informed that the 49 per cent is a total,	2	I think they are part of the one family.
3	including samples from EWL slab and NSL slab. Sorry, 49	3	Q. Dr Glover, just now I'm moving on to another topic
4	is only for EWL slab, but for the total, it's something	4	I heard you mention you said you look forward to looking
5	like 42/43 per cent.	5	at the calculation for the construction joints.
6	A. Okay.	6	A. Mm-hmm.
7	Q. If you only look at the sample taken from NSL, actually	7	Q. Can I take it you are also of the view that it is
8	the percentage is about 20 per cent.	8	appropriate to carry out checking of the internal
9	A. Okay.	9	stresses inside the connection; right?
10	Q. At the moment, this is the position at the moment.	10	A. I think if a professional person raises a legitimate
11	A. And are they better or worse?	11	issue, then it has to be considered, and so, you know,
12	Q. Well, 20 per cent of the sample exposed fails to pass	12	with that as a context, then yes, I think it's the
13	the 37mm requirement.	13	proper process to go through. I think the anxiety
14	A. Yes.	14	I have is that it takes so long to do it.
15	Q. With that level of non-compliance I put it as	15	It is not it is a calculation which can be simply
16	non-compliance	16	justified as Mr Southward indicated, and you reach
17	A. I like that, yes.	17	a situation sometimes where if you can demonstrate
18	Q do you think this gives rise to any concern as to the	18	something at such a sort of in-principle level, then you
19	effectiveness or the safety in relation to NSL slab,	19	don't dig down constantly. You don't keep looking for
20	assuming that we have 20 per cent of the couplers?	20	the black hole that's in there. You know, maths is
21	A. No. When you look at a statistical issue, you ask	21	maths, and the calculation yesterday that Mr Southward
22	yourself the question: what are the parameters that will	22	showed just took into account part of the system that
23	make it vary? So if you are looking at workmanship of	23	holds that together, and he demonstrated, I thought
24	a coupler, you would be looking at the workforce, the	24	I haven't looked at the calculations but it seemed very
25	materials they use and the conditions they are working	25	rational to me that that in itself dealt with the
	Page 162		Page 164
1	under, and there is no distinct difference between the	1	problem.
2	EWL and NSL. So they are all part of the same family,		But if you think, "No, we don't want to include
3	as far as I'm concerned. I don't differentiate between	3	that, we've got to do something else", then there's lots
4	the NSL family and the EWL family. They are all one	4	
		4	of other mechanisms in that joint which give me the
5	family.	5	assurance, without doing any more numbers.
5 6	family. Now, statisticians might disagree. They might say	5 6	assurance, without doing any more numbers. But if that doesn't pacify everybody then you have
5 6 7	family. Now, statisticians might disagree. They might say the NSL represents a different family. But then I'd ask	5 6 7	assurance, without doing any more numbers. But if that doesn't pacify everybody then you have to go the extra mile. I would rather we didn't have to,
5 6 7 8	family. Now, statisticians might disagree. They might say the NSL represents a different family. But then I'd ask them why, because I don't see it.	5 6 7 8	assurance, without doing any more numbers. But if that doesn't pacify everybody then you have to go the extra mile. I would rather we didn't have to, that's all. So be it.
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	Page 165		Page 167
1	long before the rebar in the slab would have reached its	1	the professor, I will get some way along the road this
2	yield stress"	2	afternoon, but perhaps, with approval, we might resume
3	Do you see that?	3	in the morning if need be.
4	A. Yes, I do.	4	Perhaps just starting with your experience and
5	Q. Am I right in thinking that for this statement to be	5	credentials that you shared with us earlier on. You
6	true, there is a prerequisite which is the connection	6	told us very helpfully about perhaps one of your
7	has to remain intact in order to transfer the load down	7	earliest experiences in Hong Kong and in particular in
8	to the diaphragm wall?	8	relation to the HSBC headquarter building
9	A. Yes, I would accept that, basic physics.	9	A. Yes.
10	Q. So for that purpose one has to check the stress inside	10	Q and that by a rough measure would have been sometime
11	the connection to make sure that it works?	11	in the 1980s.
12	A. Yes. Mr Chow, I've accepted the principle that the	12	A. Started in 1979.
13	calculation has to be carried out to satisfy everybody.	13	Q. There we are. Thank you. But I take it that you have,
14	MR CHOW: Thank you very much, Dr Glover.	14	therefore, over the time since that particular project,
15	I have no more questions.	15	had a level of involvement in Hong Kong projects? It's
16	CHAIRMAN: All right. Good. Thank you very much.	16	something which has been part of your professional life
17	Mr Connor?	17	since then?
18	MR CONNOR: I have some questions, if I may, please. Given	18	A. No. When I finished the Hongkong Bank, I didn't have
19	the hour and the estimate of time which I have already	19	any further involvement. I mean, clearly I come to
20	given Mr Pennicott, I will not finish today but I'm very	20	Hong Kong to speak to our people and give them lectures.
21	happy to start, if you would like me to do so.	21	Q. Yes.
22	COMMISSIONER HANSFORD: I think so, yes.	22	A. My only other involvement was with MTR from 2013 through
23	MR CONNOR: Or I can defer it entirely and start in the	23	to about 2015, as part of the international expert panel
24	morning.	24	review, and there were three others. There was myself,
25	CHAIRMAN: We might sit just a little bit later. What is	25	John Burland and Alastair Biggart Alastair was
	Page 166		Page 168
1	Page 166 our normal time? Sorry, I know I have interrupted the	1	Page 168 tunnelling, John was geotechnics and I was structures,
1 2		1 2	
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2	our normal time? Sorry, I know I have interrupted the normal time recently.	2	tunnelling, John was geotechnics and I was structures, and we looked at we came for a week, on about
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	Page 169		Page 171
1	Q. Do you recall that?	1	That's all I'm saying. And more and more in the
2	A. Yes. I mean, I don't recall your particular words, but	2	Hong Kong Code I see these rules coming in, like the one
3	let's see where you want me to go with that. I didn't	3	I talked about with ductility.
4	use those particular words.	4	For the life of me, why does someone have to write
5	Q. My apologies.	5	a clause like that, which is very precise in what it
6	A. It's okay.	6	asks for, when actually, if you stand back, you think,
7	Q. It's a rough and ready	7	well, all reinforced concrete, if it's designed in the
8	A. I speak fast.	8	way I said, where the tension/reinforcement governs, is
9	Q 4.50 pm attempt to capture your theme.	9	naturally ductile. But you do need these special
10	But we understand, or does one understand, from your	10	requirements, and they are special, when you've got
11	comment that those who are designing permanent works in	11	particular situations where you need high ductility,
12	complex infrastructure projects in Hong Kong clearly	12	like the ground movement I was talking about.
13	have to interface with those who are empowered by	13	But really, the way the rules are written, you don't
14	statute to review and approve those submissions?	14	have an option as a designer. That's what you've got to
15	A. Yes.	15	do. And I'm saying that doesn't make sense in my world.
16	Q. And is your reference to prudence and conservatism on	16	But I live in a different world.
17	the part of those who approve something which is part of	17	Does that help you?
18	your evidence to this Commission?	18	Q. It is very helpful indeed, thank you, because I think
19	A. Yes. Crumbs how much time have we got? No, this was	19	what again, if I may play back to you what
20	not my words were general, observational. Remember,	20	I understand you to be telling us it's that given
20	when I did my reviews with MTR and interestingly	20	those rules, that rule book, and the way in which
21	enough none of them were on this station, none of them	21	therefore, as a designer, one must approach matters,
22	at all but I found certain illogicalities in the	22	then there's an inevitable observance and understanding
23	thinking that had been applied to particular situations,	23	of what the content of the rule book is and what the
24	and I just used the ground one here because I know that	24	likelihood is of, shall we say, those rules being flexed
23	and I just used the ground one here because I know that	23	incentioou is of, shall we say, those fulles being flexed
	D 150		D 170
1	Page 170	1	Page 172
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1	Page 177		Page 179
1	and prudent design, because if one doesn't put	1	issues, that the designer has to take into account at
2	a conservative and prudent design forward, then frankly	2	that stage, of bringing the permanent works design
3	it's going to, to use a railway metaphor, hit the	3	together, to ensure that he puts forward something which
4	buffers somewhat; would that be fair?	4	is going to do the job, but again, having regard to the
5	A. It would be an interesting our experience in the UK	5	stakeholders and all the interests and the rules you
6	at the moment with Brexit is a classic example, really,	6	mention, is articulated in a way that is not going to
7	where	7	hit opposition?
8	Q. No, we definitely don't have time for that!	8	A. Yes.
9	A. It's a classic example where you can't satisfy all the	9	Q. Just to give a flavour of that and thank you for your
10	parties, and in the end because someone quite genuinely	10	response to that if you could have before you just
11	sets out to satisfy all the parties, you end up with	11	a drawing to illustrate matters, drawing H559, please.
12	an absolute mess that doesn't satisfy anybody.	12	That should appear on the screen in just a moment there.
13	COMMISSIONER HANSFORD: I think that is beyond the brief.	13	A. Yes. I've got it.
14	A. I know. Sorry, that was ex-censorship. We can delete	14	Q. Thank you. A drawing that you will be well familiar
15	that from the record.	15	with or ones rather like it.
16	COMMISSIONER HANSFORD: We do understand that point.	16	But again, just to emphasise the nature of the
17	A. That's what I'm saying. You've got to have people who	17	project itself, what we see to the left-hand side of the
18	have authority and responsibility. If you have people	18	structure as shown in the drawing in shading, as you
19	who have authority but no real responsibility for the	19	will see at about the line from the top, K1, and to the
20	final outcome, then you've really got a problem on your	20	left of that, the designer, in approaching this project,
21	hands.	21	would have had to have regard of course to the perimeter
22	MR CONNOR: So with that and I mention those five areas	22	walls and the reinforcement of those perimeter walls to
23	that I at least have in mind for the purpose of looking	23	minimise the ground movements, to prevent damage to the
24	at influences on the approach to design the first of	24	existing infrastructure, et cetera, around it. So that
25	those I suggest to you was the nature of the project in	25	would be an example of the kind of thing you and I have
	Page 178		Page 180
1	question, and I think you do come to say some words on	1	just been talking about?
2	this in your report which I think we might come to	2	A. Yes.
3	tomorrow, but I think you have very fairly shared it	3	Q. Thank you. The second area we may come back to that
4	with us earlier on in your presentation, that in terms		
	• •	4	drawing in a moment, or tomorrow morning, if I'm
5	of the nature of this project and approaching the design	5	drawing in a moment, or tomorrow morning, if I'm permitted was complexity itself of the project, and
5 6	of the nature of this project and approaching the design of it, one would have had to have regard to not only,	5 6	drawing in a moment, or tomorrow morning, if I'm permitted was complexity itself of the project, and in particular the structure that's required to be
5 6 7	of the nature of this project and approaching the design of it, one would have had to have regard to not only, shall we say, the job in hand, the extension of the	5 6 7	drawing in a moment, or tomorrow morning, if I'm permitted was complexity itself of the project, and in particular the structure that's required to be designed.
5 6 7 8	of the nature of this project and approaching the design of it, one would have had to have regard to not only, shall we say, the job in hand, the extension of the station in the form that's been anticipated, but the	5 6 7 8	drawing in a moment, or tomorrow morning, if I'm permitted was complexity itself of the project, and in particular the structure that's required to be designed. Again, we have talked a lot this afternoon and on
5 6 7 8 9	of the nature of this project and approaching the design of it, one would have had to have regard to not only, shall we say, the job in hand, the extension of the station in the form that's been anticipated, but the protection of the existing structure?	5 6 7 8 9	drawing in a moment, or tomorrow morning, if I'm permitted was complexity itself of the project, and in particular the structure that's required to be designed. Again, we have talked a lot this afternoon and on other days about the EWL slab in particular and its very
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	Page 181		Page 183
1	A. Yes. It's heavily perforated, yes. I'm not sure what	1	he has given an indication of a number of helpful
2	I'm agreeing to, because you've told me it's got lots of	2	observations, and a view that perhaps, shall we say,
3	holes in it and I've agreed with you. Is that what you	3	puts the comments in his report in greater context for
4	meant?	4	these purposes.
5	Q. It is, but I'll take your engineering expression in	5	COMMISSIONER HANSFORD: I think we should be careful that he
6	those circumstances.	6	hasn't agreed to something you haven't asked him yet.
7	A. And you could also add they are at mid-span does that	7	MR CONNOR: No, absolutely. Perhaps, with your blessing, we
8	help you to put your argument?	8	might close off on this particular point, sir.
9	Q. It does, because the inclusion of all of those and the	9	CHAIRMAN: Yes.
10	demand for all those would have otherwise constrained	10	MR CONNOR: And then resume in the morning with a view to
11	the spanning capability of that slab, but of course the	11	concluding this number of questions.
12	intricacy with which the work is applied has to	12	If I may, sir
13	anticipate that and deal with it; yes?	13	CHAIRMAN: Yes.
14	That in itself raises, no doubt, demands as to the	14	MR CONNOR: You were kind enough to suggest that you might
15	way in which the arrangement of rebar is allowed for	15	agree, but let us see if you do.
16	within a structure like that or a piece of structure	16	You have agreed that the complexity of a project is
17	like that.	17	something which quite rightly, against the background of
18	A. I think I know where you are coming from. Can I help	18	the rules of approval, the way in which it may be
19	you to get to what you want? Because, I mean, it's	19	applied, et cetera, is something which a designer will
20	a very nice story, but what is it you want me to say?	20	have in contemplation and consideration when putting his
21	I'm sorry, I don't mean to be I didn't mean it like	21	permanent works design together in Hong Kong, and that
22	that but it's getting towards the end of the day and I'm	22	would apply to the Hung Hom project, and of course this:
23	sure I'm going to agree with you but I'm not sure what	23	that it is understandable, against that background
24	it is you want me to agree with.	24	bearing in mind the nature of the project and complexity
25	Q. I like your approach. It's a very, very helpful	25	of it, the demands for programme and so on that
	Page 182		Page 184
1	approach.	1	a conservative approach, which anticipates the likely
2	MR PENNICOTT: Dr Glover, if I may say, I think we'd all	2	blockages, views and application of the rules may have
3	like some guidance on where all this is going because	3	in mind, would be deployed?
4	I have to say at the moment I'm a little bit confused.	4	A. I think that's true. What you are trading there is you
5	CHAIRMAN: I'm just wondering, Mr Connor, all of it is	5	are trading, let's say, the efficiency of the design
6	helpful, but I wonder if it's not more helpful by way of	6	against a time scale, and you've got limited time and
7	final submissions, because it seems to me that what you	7	you've got some very real constraints on that side,
8	are putting is self-evident, and not only to an expert	8	exacerbated by the limitations that have been placed on
9	but I would imagine to well-informed laypersons. We	9	such constructions, and I mean by that the 25 millimetre
10	appreciate it's a complex project. We appreciate that	10	displacement or settlement at ground level which in some
11	the slab is not merely just a great chunk of concrete,	11	situations is remarkable in terms of its difficulty.
12	it's something far more complex than that. And we	12	So with that as a backcloth, yes, you've got to take
13	appreciate the dynamics which both help and constrict	13	a conservative view. If you had more time, if you had
14	designers.	14	a more benevolent approval system, then I think you
15	So all of that we would be delighted to hear from	15	would have ended up with a better design, less
16	you within your final submissions, but I don't know that	16	conservative, more considered. But within the context
17	it needs the imprimatur of Dr Glover necessarily, in	17	of the limitations you had, I can fully understand what
18	this area.	18	you've done, and I've not said anything to the contrary,
19	MR CONNOR: That's helpful in itself, sir, but to an extent,	19	to the best of my knowledge, maybe; I had to think about
20	because of the wording and the opinions which he has	20	that one.
21 22	sought to apply, which we will be coming to tomorrow, in	21 22	MR CONNOR: Thank you. That's a helpful point on which
22 23	certain of his opinion and report to you, it is something that one has to address. But it may well be	22	I might suggest, sir and Professor, we might pause this evening.
23 24	that given where we have got to already with him, one	23	CHAIRMAN: All right.
24 25	can do it fairly briskly in the morning, because I think	24	MR CONNOR: And probably as far as tomorrow is concerned,
1 4 3	can do it fairly offskry in the morning, because I tillik	- 25	The controls. The probably as far as follottow is collectified,

	Page 185		Page 187
1	I'm estimating something in the order of about	1	issues with that, no doubt they will tell us.
2	15 minutes or so to conclude matters.	2	Certainly for our part, when we have been
3	CHAIRMAN: All right. Thank you. It's very difficult.	3	struggling, despite the endeavours of this week, to
4	Either Mr To I suppose it's impossible for you to	4	progress our closing addresses in writing, we have
5	know because you don't know what you are going to be	5	certainly managed to incorporate some drawings and
6	instructed.	6	photographs and so forth into our closing submissions,
7	MR TO: That's true. I was aiming this afternoon for maybe	7	and I hope I'm sure that's all very acceptable. But
8	15 minutes but Prof Yeung does have something he wants	8	of course your report is far more important because
9	me to convey.	9	that's going to be made public in due course.
10	CHAIRMAN: All right. May I just give a warning order: we	10	So if anybody has a problem, no doubt they will let
11	would very much like to finish the expert evidence	11	us know.
12	tomorrow, and depending on how we are going and subject	12	CHAIRMAN: Thank you.
13	to guidance from counsel, if necessary we would look to	13	MR BOULDING: Sir, may I just raise two points?
14	sitting a little bit later, if we can clear everything.	14	CHAIRMAN: Yes.
15	We are thinking of maybe 6 o'clock or something like	15	MR BOULDING: Firstly, I wonder whether it's attractive to
16	that. We are not talking about people sort of having to	16	you to start at 9.30 tomorrow to ensure we finish and we
17	have supper here or anything like that, but even if it's	17	don't have to sit too late.
18	6.10 or something but we can clear it all, then all the	18	I suspect you are just about to read the riot act to
19	expert evidence is finished. I'm sure you will agree	19	Dr Glover but those instructing me need to re-arrange
20	it's better than coming back at the end of the weekend.	20	his flight home and I wonder whether they can be
21	All right?	21	permitted to speak to him about that.
22	So absent anybody having any particular pressing	22	MR PENNICOTT: Of course. There's absolutely no objection
23	other engagement, which we will obviously take into	23	to that.
24	account, just bear that in mind. We hope it won't be	24	CHAIRMAN: Dr Glover, in his evidence so far, has said
25	necessary but bear it in mind.	25	nothing about his flights home, so we will work on the
	Page 186		Page 188
1	Page 186 MR PENNICOTT: Sir, I very much hope it won't be necessary	1	Page 188 basis that's an entirely extraneous matter.
1 2		1 2	
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